AU/ACSC/6456/2004-2005

AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

LUFTWAFFE MARITIME OPERATIONS IN WORLD WAR II: THOUGHT, ORGANIZATION AND TECHNOLOGY

by

Winston A. Gould, Major, USAF

A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

Instructor: Dr Richard R. Muller

Maxwell Air Force Base, Alabama

April 2005

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
APR 2005		**00-00-2005 to 00-00-2005**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
LUFTWAFFE MARITIME OPERATIONS IN WORLD WAR II: THOUGHT, ORGANIZATION AND TECHNOLOGY	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air University Press (AUL/LP),131 W Shumacher Avenue,Maxwell AFB,AL,36112-6615**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The development of airpower can be traced to three key elements: thought, organization and technology. The Luftwaffe of World War II is no different. This paper will examine the Luftwaffe's thought, organization and technology as it pertains to maritime operations, or as the modern United States Air Force (USAF) calls it, Countersea Operations. These maritime operations will include direct support of the Kriegsmarine and independent Luftwaffe operations against the Allies. Luftwaffe thought will show that doctrinally the Luftwaffe was not as prepared for the maritime role its leaders thrust upon it, but flexibility and the application of the tenets of airpower provided the basis for adaptation. Also included will be an examination of the fierce rivalry between the Luftwaffe and Kreigsmarine senior leadership and how this interfered with the conduct of countersea operations. Luftwaffe organization during World War II provided a more than adequate basis for conducting the countersea campaign. The adaptability of the operational and support structure allowed the Luftwaffe to accomplish a variety of missions, even as their aircraft and weapons were proving deficient. Finally, the Luftwaffe was at the forefront of innovation in the field of aviation technology, including airframe and weapon development. Once again, interference by senior leadership and equipment teething problems combined with increasing Allied attacks cost the Luftwaffe precious time.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**59**	

Disclaimer

The views expressed in this academic research paper are those of the author(s) and do not reflect the official policy or position of the US government or the Department of Defense. In accordance with Air Force Instruction 51-303, it is not copyrighted, but is the property of the United States government.

Preface

The German Luftwaffe maritime forces were colloquially known as "Der See Adlers", or "The Sea Eagles." This particular breed of the Luftwaffe developed its own doctrine and tactics to accomplish the many unique roles it was assigned. Units were created to meet unique requirements, often in response to a pressing need and learning from expensive and painful lessons. German ingenuity and creativity once again came to the forefront in the adaptation of current technology and the development of special weapons to support maritime operations.

The German Luftwaffe of World War II is well known for its role in supporting the "Blitzkrieg" tactics of the Wehrmacht Heer, or German Army. Another important role was the use of the Luftwaffe in maritime operations in support of the Kriegsmarine. This research paper will examine the role of the Luftwaffe in maritime operations, specifically in the Atlantic area of operations. First, this paper will examine the thought and doctrine of the Luftwaffe in maritime operations. Secondly, this paper will examine the organization of the Luftwaffe, specifically the units employed in maritime operations. Finally, this paper will examine the technology employed by the Luftwaffe in maritime operations.

I would like to acknowledge the guidance received from my research advisor, Dr Richard R. Muller. His expertise and vast knowledge of the Luftwaffe in World War II assisted in “zeroing in” on the subject. I would also like to acknowledge the wonderful assistance of Miss Terry Kiss of the Air University Library. Her tireless efforts searching for reference material were invaluable. Finally, I would like to thank the Toni Petito of the Air Force Historical Research Agency. The AFHRA’s vast repository of translated German documents provided immeasurable information for this paper.

Abstract

The development of airpower can be traced to three key elements: thought, organization and technology. The Luftwaffe of World War II is no different. This paper will examine the Luftwaffe's thought, organization and technology as it pertains to maritime operations, or as the modern United States Air Force (USAF) calls it, Countersea Operations. These maritime operations will include direct support of the Kriegsmarine and independent Luftwaffe operations against the Allies. Luftwaffe thought will show that doctrinally the Luftwaffe was not as prepared for the maritime role its leaders thrust upon it, but flexibility and the application of the tenets of airpower provided the basis for adaptation. Also included will be an examination of the fierce rivalry between the Luftwaffe and Kreigsmarine senior leadership and how this interfered with the conduct of countersea operations. Luftwaffe organization during World War II provided a more than adequate basis for conducting the countersea campaign. The adaptability of the operational and support structure allowed the Luftwaffe to accomplish a variety of missions, even as their aircraft and weapons were proving deficient. Finally, the Luftwaffe was at the forefront of innovation in the field of aviation technology, including airframe and weapon development. Once again, interference by senior leadership and equipment teething problems combined with increasing Allied attacks cost the Luftwaffe precious time.

Contents

Page

List of Figures

Page

List of Illustrations

Page

Introduction

Throughout the history and development of airpower, three key themes emerge. These areas are thought, organization and technology.[1] Thought, many times born as an idea or concept to do things better, develops into an air service's doctrine. This doctrine is often responsible for the development of organization and technology, but not necessarily so. There are many examples in the past 100 years of airpower where the organization of an air arm or a rapid technological development changed the way of war in the air. The Luftwaffe of World War II was one such example.

The Luftwaffe of 1939 was a culmination of many years of secretive pre-war development in all three areas: thought, organization and doctrine. Although banned by treaty from having an air service, German foresight placed key airmen on the staffs of the post-Great War German Army. The lessons of World War I were still fresh on the minds of Germany's airmen, as well as the hard lessons learned from active service in the Spanish Civil War. It was the combination of these two events that shaped the World War II Luftwaffe. What the world saw in the 1939 Luftwaffe was a service dedicated to a major ground war, with very little interest in the war at sea. The Chief of the Air Staff, Generaloberst Hans Jeschonnek, believed that the Luftwaffe, in the form of twin-engined medium bombers and single-engined dive bombers, could win the war on the ground along with the German Army and its tanks.[2] The German High Command, especially Adolf Hitler and Reichsmarschall Hermann Goering, among others, also believed in this course of action to win the war in Europe and bring Great Britain to the negotiating table. Truth be known, the thought of a prolonged maritime campaign probably scared Hitler and Goering, based on the effects of the blockade of Germany in World War I.

This paper will first examine Luftwaffe thought and doctrine. This is critical to understanding the lack of preparedness on the Luftwaffe's part for maritime operations. As General Curtis Lemay said: "At the very heart of warfare lies doctrine…It is the building material of strategy. It is fundamental in sound judgment." German air doctrine was not prepared for the countersea role its leaders thrust upon it. It is here that the German leadership turned a house of brick into a house of straw.

Secondly, this paper will look at the Luftwaffe's organizational structure. Unlike their doctrine, the Luftwaffe's organizational structure was more than adequate for the task and provided an enabler for the tactical and operational execution of the war, whether accomplishing counterair, counterland or countersea missions. Strategically, operationally and tactically, Luftwaffe organization was sound, even adapting organizations "on-the-fly" to meet specific theater demands. However, it was the execution, or operational use, of this structure and the inflexibility of leadership which proved to be the Achilles Heel of the Luftwaffe.

Finally, after looking at Luftwaffe thought and organization, this paper will discuss German weapons development for the countersea role. The importance of the airplane and how it supported German aspirations in the maritime environment cannot be overstated. Included will be a brief overview of the use of land and sea-based aircraft as well as the still-borne aircraft carrier program. Also, German technical prowess at weapons development and the innovative use of guided bombs and missiles will be discussed.

This thesis will focus on the Battle of the Atlantic during the period 1939-1945, with brief interludes elsewhere as necessary to provide reference points. The three levels of war will be examined as required, with the focus being on how the Germans employed the Luftwaffe at the operational level of war.

Luftwaffe Thought and Doctrine

This concept of a ground-oriented air force, as well as sharp disagreements between the senior leadership of the Luftwaffe and the Kriegsmarine, severely hindered the development of Luftwaffe countersea operations. The basis for Luftwaffe doctrine and operations initially was heavily, though by no means totally, influenced by the theories of the Italian General Guilio Douhet.[3] However, the doctrine with which the Luftwaffe started World War II is truly a mix of theories from the inter-war years. A simple literature review will show how little there is in the way of countersea doctrine developed by the Luftwaffe during immediate pre-war years and continuing into World War II. It is especially telling because the German Armed Forces of World War II prided themselves on sound doctrine as a basis for Auftragstaktik, or mission-directed orders – the ability of the small unit and individual to shape the battlespace using knowledge of the commanders' intent and doctrine. Doctrinally, Luftwaffe - Kreigsmarine cooperation simply does not seem to exist to the same quantity or quality of Luftwaffe – Heer doctrine. This being said, pre-war doctrine for joint operations existed in the form of Luftwaffe Regulation 16, *Conduct of Aerial Warfare*.

Doctrine: Evolution or Dogma

Proper development of military doctrine involves a five-step process. This process involves studying the events of the past as they pertain to the particular area of interest. In studying these past events of history, perception is reality and the individual does not necessarily know what really happened – just what his lens allows him to see. Theories are developed based on this study of history. These theories may or may not be correct, based on the perspectives and

perceptions of the individual creating the theories. These theories should be tested in an operational environment such as exercises and war games prior to being formalized into doctrine. This doctrine provides the basis for strategy, or the projected conduct of an operation, campaign or war. This strategy is then executed, once again, preferably in realistic exercises and war games that should allow any faults and deficiencies to show, but not necessarily so.[4]

The thorough development of doctrine is an evolutionary process that fully takes into account the five step process. The pre-war Luftwaffe followed this doctrine development process. The Luftwaffe studied the lessons of air warfare from World War I. The doctrine developed by the Luftwaffe during the inter-war years was influenced by external and internal factors. German military staff officers carefully monitored foreign air force developments, like French Air Force army support operations, and studied air power theorists like Guilio Douhet.[5] This was balanced by German internal leadership and theorists, like Generalleutnant Walther Wever, Oberst Robert Knauss and Oberst Helmuth Wilberg, exerting their own thoughts on the doctrine development process.[6] Once established as a separate armed force in 1935, the Luftwaffe wasted no time in issuing formal doctrine as Luftwaffe Regulation 16. Luftwaffe Regulation 16s proving ground would be the Spanish Civil War, with the Condor Legion supporting the Spanish Nationalists under Francisco Franco. Luftwaffe Regulation 16, and the lessons learned from the Spanish Civil War, provided the basis of strategy that the Luftwaffe would take to war in 1939.

The way that doctrine development turns from an evolutionary process to a dogmatic process is through a failure to study the history of previous executions and not developing proper theories based on the study of history. The Luftwaffe did not have the luxury, or take the time, to follow the complete doctrine development process. Thus, as a result of shortsightedness and

the pressing military situation facing the Luftwaffe, as well as the other German Armed Forces, doctrine was developed, and strategy planned, based on the previous operational experience.

The influence of Douhet and the Spirit of the Offense

There is considerable debate over the influence of Guilio Douhet on the development of the Luftwaffe of World War II. Luftwaffe doctrine of 1926 places considerable emphasis on the strategic attack of the enemy's populace.[7] However, the doctrine of 1935 (Luftwaffe Regulation 16) deals with offensive air power, to include attacking the enemy's rear areas and homeland.[8] The primary difference between this discussion and Douhet's theory lie in the fact that Douhet targeted the enemy's population to end the conflict and the Luftwaffe writers targeted the enemy's armed forces, including industrial support, to bring an end to a conflict. This emphasis on strategic attack showed in the force structure with which the Luftwaffe began the war. In 1939, over 40 percent of the Luftwaffe's aircraft were bomber and dive-bomber units, while only 25-30 percent were fighter units. Of these, many were twin-engined fighter bombers for tactical support of the Army.[9]

A moment that would characterize the German war effort throughout World War II occurred during April 1942. Hitler ordered the Luftwaffe to attack small British town cultural centers in retaliation for RAF attacks on Rostock and Lubeck. These so-called 'Baedecker attacks' had no military effect except the dissipation of forces.[10] In response to the operations at hand, Lieutenant General Kessler, CINC Fliegerführer Atlantic wrote: "My impression in the majority of cases, the aim of our sorties at present is more to placate the High Command than to cause any serious discomfort to the enemy. Of, for example, bombs dropped on English country houses where dances are taking place, there is little possibility of killing anyone of importance,

since Churchill doesn't dance, and other prominent personalities are generally beyond the age for such relaxation."[11]

Luftwaffe Regulation 16

"No airman can do his job properly if he is engaged one day in combined operations with the Army over land; the next day in operational flying kilometers behind the enemy line; and the third day over the sea with both his own and enemy naval units below him."

Grossadmiral Erich Raeder[12]

The father of the 1935 Luftwaffe Regulation 16 was Generalleutnant Walther Wever. An army officer by trade, General Wever realized the effects that naval air forces had over the sea during World War I and was responsible for ensuring that countersea operations were included. Although not an aviator, General Wever recognized the extensive power projection capabilities of the Luftwaffe, including the task "…to support naval operations by attacking enemy naval bases, protecting Germany's bases and participating directly in naval battles."[13] General Wever made such an impact and lasting impression that he is still spoken highly of in today's Luftwaffe.[14] Although *The Conduct of Aerial War* was created under Wever's direction it can be best understood as a product of the combined effort of the Luftwaffe general staff, expressing the war philosophy commonly held by the Luftwaffe's senior leaders in 1935.[15]

Luftwaffe Regulation 16 emphasized the following in the section entitled "Air Force/Naval Cooperation:"

- Should there be no maritime cooperation possible; the air force will be able to use its strongest forces available in air operations.
- The primary targets of the air force in this environment are the enemy fleet and air units. This will degrade his ability to execute naval operations.
- The air force can also support the navy by carrying out operations against enemy ports as well as against his import and export.

- These attacks may not always be carried out in coordination withy naval operations, but have to be in cooperation with naval objectives.
- Only a part of the air force will be used to carry out naval operations, and then, secure means of communication have to be established between navy and supporting section of the air force.
- The operations of the army navy and air force have to be coordinated in such a manner that maximum overall effectiveness is achieved.[16]

This small section however, did not subjugate any Luftwaffe forces to Kriegsmarine control . This is in direct contrast to the Luftwaffe-Army arrangement stated in Line 121, which states: "Direct cooperation with and direct support of the Army are missions primarily of those units of the Luftwaffe which are *allocated to and assigned under the Army* for reconnaissance and air defense purposes. The types of forces in question include reconnaissance, antiaircraft artillery, aircraft reporting, and, if the current situation on the ground requires and the overall situation permits, fighter forces."[17] (Emphasis added) Grossadmiral Erich Raeder and his successor, Grossadmiral Karl Doenitz were only able to achieve this kind of allocation after much badgering, bickering and cajoling. Even after achieving a "victory" for force allocation and control, the arrangements were often overturned depending on Hitler's mood at the time.

In comparison, the current United States Air Force (USAF) views countersea operations as an "add-on" mission. USAF Air Force Doctrine Document 2-1.4 states the following: "The countersea function is an extension of Air Force functions into the maritime environment. Countersea is a *collateral function* which is defined by JP 1—02 as "a mission other than those for which a force is primarily organized, trained, and equipped, that the force can accomplish by virtue of the inherent capabilities of that force." Identified specialized collateral missions are sea surveillance, surface warfare (SUW), protection of sea lines of communications through undersea warfare (USW) and air warfare (AW), aerial minelaying, and air refueling in support of naval campaigns. *The Air Force fulfills these collateral missions through the primary functions*

of aerospace forces, such as interdiction, counterair, ISR, and strategic attack. As with the other aerospace functions, countersea operations are designed to achieve strategic–, operational–, or tactical–level objectives in the pursuit of joint force objectives in the maritime environment. In fact in AFDD 2-1, *Air Warfare*, countersea operations are the only Air Force function, of the 15 listed, that is a "collateral" function. Counterland is listed as a function that should be achieved at the superiority level on the battlefield. Unlike the Luftwaffe, this is not short-sightedness on the U.S. military's part, but the fact that the United States Navy (USN) is responsible for the primary countersea mission.

Luftwaffe Regulation 16 continued in its original form throughout the war, with a minor update in 1940 based on experience in Spain and the Polish Campaign. The operational methods of the Luftwaffe were updated by the issuing of Taktische Bemerkungen, or "Tactical Observations." These "Tactical Observations" were issued by the Ober Kommando der Luftwaffe (Luftwaffe High Command or OKL) Operations Branch, Training Department, and signed out by the Luftwaffe Chief of Staff, as a "lessons learned" from the field.[18] The Luftwaffe, as well as the other German Armed Forces, did not have the luxury of studying history and truly evolve doctrine. The Luftwaffe did, however, test theories and operational lessons, at least early in the war.[19] Germany would have to wait many years after being defeated in World War II to even get a chance at developing its' own military, much less the doctrine to operate from. In this end, many former wartime leaders, especially from the tactical ranks, would lead the new Luftwaffe of the German Federal Republic.

German military leadership and their impact on thought and doctrine

"6. Only one who fully understand the demands of air warfare can be an air force leader. True leadership demonstrates trust and gives the troops an irresistible power to achieve goals that seem unreachable. Personal example, the presence of the leader at the point of gravest

danger, outstanding knowledge, a strong will, calm, perseverance and confidence in troop-handling and decision-making, flexibility, joy in responsibility, a spirit of fellowship, and the untiring care for the well-being of the soldier-all these create in misery and death an unbreakable fighting fellowship.

7. The senior commander is generally not required to personally lead his troops into battle. He should no, however, miss any opportunity to provide personal example. Regular flights to the front or fighting area provide a vivid example of the war situation and its requirements." (Luftwaffe Regulation 16, The Conduct of Aerial War (Corum/Muller, 120)

One cannot ignore the major personalities that were in constant conflict over the support of maritime operations and the Luftwaffe roles during World War II. The on-going conflict between Reichsmarschall Hermann Goering and Grossadmiral Erich Raeder over naval air power was legendary. It can be said that there ran some common threads between the two. Both Reichsmarschall Goering and Admiral Raeder were loyal National Socialist Party members ("Nazis") with utmost obedience to Adolf Hitler. Each man wanted his service to grow and gain prominence within the overall scheme of German military power. But, it was the differences that accentuated the sharpness of their quarrels.

Reichsmarschall Hermann Goering was a forceful, supremely confident, energetic individual who took every affront personally, whether it was intended or not.[20] Goering's ruthless energy and innate forcefulness of character inspired the early build up of the Luftwaffe and he saw it as his.[21] However, "Goering's incredible egotism was clearly a serious and dangerous drawback in a man entrusted with the fate of an entire service."[22] Indicative of his egotism, Goering dreamed of his airmen decimating the Royal Navy and proposed a mass attack on the Home Fleet's base at Scapa Flow at the outbreak of the war...he encouraged attacks upon the Royal Navy at sea in a succession of OKW directives.[23] Perhaps most telling is his contempt for transport pilots. Goering, like a former USAF Chief of Staff, held "non-combat" transport pilots in much disdain. One wonders how the Ju-52 pilots dropping parachutists over Crete or bringing supplies to Stalingrad would have felt about their "noncombat" duty.

Grossadmiral Erich Raeder was another "man on a mission." His mission was to build a formidable navy to fight Britain on the open ocean. Although he wanted a separate naval air arm, he was a battleship general. Admiral Raeder viewed the naval air arm as a support mechanism for the fleet, primarily as a reconnaissance force to find enemy fleets.[24] Unlike Goering, Admiral Raeder was a brilliant strategist and well suited to leading the Kriegsmarine. Time and again his leadership proved the difference between success and failure. It is telling that when a major operation failed (Operation Regenbogen-Rainbow), that Admiral Raeder resigned from his duties as CINC Kriegsmarine to save the navy.[25] On 30 January 1943, Raeder summed up his career up to this point: "the entire time in Berlin has been a period of very difficult, continuous battles; only the battle front changed over the course of time. In the beginning there was a struggle against the ministries such as Groener and von Schleicher, struggles in the beginning against the army…then against the Luftwaffe."[26]

A key example shows the sorry state of affairs between the Luftwaffe and Kriegsmarine, most of it a direct result of their pettiness. Adam Claasen states this about early air-sea cooperation: "In the months ahead, combined navy-Luftwaffe actions were at best poor, and on occasions appallingly bad. Operations in October and November 1939 and February 1940 clearly exposed the poor preparation and attention to the demands of air and sea cooperation."[27] This was exemplified by Luftflotte 5's operations in the Norwegian theater, which included fratricidal sinking of the German destroyers *Maass* and *Schultz*, British reconnaissance planes flying unhindered over Narvik, and the poor support of operations by the *Tirpitz* by the Luftwaffe.[28]

On 9 June 1942, the German Naval Staff made the following entry in the OKM war diary:

> "As a result, the Luftwaffe will simply have to acknowledge once more that the RAF is numerically better to cope with the more or less self-evident fundamental requirements of any sort of naval warfare. This example[of 26, 27, and 28 May] shows with striking clarity a discrepancy that can never be sufficiently regretted, namely, the absence of a naval air force or even a certain amount of authority of naval commanders over air forces."[29]

About the same time, the Kriegsmarine requested additional reconnaissance assets to support operations in and around Norway. The Luftwaffe's Operations Staff, as could be expected after suffering such a diatribe in an official war diary, responded by issuing a directive that "Additional reconnaissance forces cannot be furnished and under no circumstances are bombers to be used for reconnaissance tasks only." Admiral Raeder's staff proposed that the "attitude of the Luftwaffe's Operation Staff be mentioned to the Fuhrer", much like a child would tattle to daddy.[30] This adversarial relationship between the Luftwaffe-Kriegsmarine continued for the remainder of the war, with telling results.

To sum up the problems of the German senior leadership and the petty, internecine squabbles, Sonke Neitzel states it the best when he wrote: "The Luftwaffe crews certainly tried to do their best to accomplish their tasks in the missions over the sea. The basic fault of the way in which Germany conducted the war was its policy in making appointments to the highest leadership. What resulted was inexcusable blunders on the part of the high command, which showed clearly the futility of their actions. The air war over the sea, more than war in any other theatres, required long-term planning and exemplary inter-service cooperation. As improvisation on such a scale was hardly possible, the successes achieved could not but remain below expectations. From the very beginning the few units which operated over the sea were overtaxed to an even greater degree than the rest of the Luftwaffe."

Summary

Whatever influence General Guilio Douhet may have had on the pre-war development of Luftwaffe doctrine, it is very clear that the Luftwaffe developed its own brand of aerial warfare by the start of World War II. The Luftwaffe way of war was very terrestrial in orientation, with war on the continent, and not on the ocean, at the forefront of doctrine and thought. A professional military force generally follows an evolutionary process to properly develop doctrine. However, the Luftwaffe became dogmatic by the very nature of the war that was thrust upon it. The pre-war doctrine, in the guise of Luftwaffe Regulation 16, provided a sound basis for the conduct of strategy on the ground, but was severely lacking for countersea operations. This deficiency, exacerbated by child-like squabbles among the senior Luftwaffe and Kriegsmarine leadership and transferred to their staffs, ultimately failed the German nation during its conduct of the war in the Atlantic.

Luftwaffe Organization

Personalities notwithstanding, the Luftwaffe of 1939 was organized for success. The See-Luftstreitkrafte had developed a "niche market," albeit one of Reichsmarschall Goering's design. Although unintended, the Luftwaffe general in charge of the See-Luftstreitkrafte, although performing an important role, was not truly in command of "his" forces. The Luftwaffe was organized along the modern levels of war. The strategic level leaders concentrated on the long-term, "big picture" strategy and conduct of the war, as poor as some of their decisions were. The operational level leaders were given the task of planning and conducting operations within certain theaters and/or being responsible for a particular organizational function that covered different theaters. The tactical leadership of the Luftwaffe remained outstanding throughout World War II. However, the toll in experienced manpower placed unimaginable strains on the tactical airmen in leadership positions as the war ground on. The Germans, probably more than any other country during World War II, were adept at organizational flexibility. By organizing along cross-functional lines, the Luftwaffe built a combat structure that should have won the war in the Atlantic. Once more, though, their senior leadership and the deteriorating situation of a multiple front war placed too many demands on too few resources.

The See-Luftstreitkrafte

At the beginning of World War II, the Kriegsmarine had possession of a small naval air arm called the See-Luftstreitkrafte (literally Naval Air Arm). Admiral Raeder wanted a separate naval air force, under complete control of the OKM, to accomplish the full range of naval operations. The German naval staff recognized the potential of aviation and the ability of aircraft to scout and respond to changes in the naval tactical situation.[31] A compromise existed between 1935 and 1939 when Reichsmarschall Goering decided to change the plan. In a memorandum

between Reichsmarschall Goering and Admiral Raeder, the organization and responsibility of naval aviation was clarified. This agreement left the See-Luftstreitkrafte with responsibility for the conduct of aerial reconnaissance and direct aerial support of fleets in contact with the enemy.[32] Admiral Raeder felt that he had to accept this agreement with the hope of fully developing the See-Luftstreitkrafte as time went along.

As part of this memorandum, the command of the See-Luftstreitkrafte rested with the OKL-Fuhrer der See-Luftstreitkrafte (Luftwaffe Commander of the Naval Air Arm). The OKL-Fuhrer der See-Luftstreitkrafte, Generalmajor Hans Ritter, reported to the CINC Luftwaffe and was the direct Luftwaffe liaison with the Kriegsmarine.[33] The OKL-Fuhrer der See-Luftstreitkrafte primary duties were to prepare the Maritime Air Forces for operational use in cooperation with the Luftwaffe General Staff and Naval Command; and to supervise serviceability, supply and training of Maritime Air Forces in cooperation with the Luftwaffe Quartermaster General (Q.M.G.).[34] At the beginning of the war in September, 1939, the See-Luftstreitkrafte had 14 Kustenfliegerstaffeln (Coastal Reconnaissance Squadrons), one Bordfliegergruppe (Ship-based flying squadron), BFGr 196, and one Tragerverbande (Aircraft Carrier Unit) under its' operational control.[35] This position was terminated 1 April 1939 and the See-Luftstreitkrafte was formally disbanded.[36]

A new command and operational structure for maritime aerial operations was developed. The new position was the General der Luftwaffe beim Oberkommando der Kriegsmarine, or the General der Luft. The new structure created the Fuhrer der Luft West and the Fuhrer der Luft Ost (Commander of Air West and East, respectively). Each Fuhrer der Luft was tactically subordinate (under tactical control, or TACON, in modern parlance) to the Marineoberkommando West and Marineoberkommando Ost respectively, but administratively

subordinate (under administrative control, or ADCON) to the General der Luft. The Marineoberkommando West was responsible for the North Sea, Eastern Scottish harbors, the area of West Norway-North Scotland-Iceland, the Denmark Strait and Greenland. Marineoberkommando Ost's area of responsibility included north of Norway and east to the White Sea, the Kola Peninsula, Murmansk, Archangel, the North Cape and Spitzbergen.[37] (Each area had latitude and longitudinal limitations not included here) Each Marineoberkommando operationally reported to the OKM Operations staff, which meant that the CINC Kriegsmarine exercised operational control, or OPCON, over the assigned forces of each Fuhrer der Luft.[38] Thus, the General der Luft was restricted to organizing and structuring units, and was often left "out-of-the-loop" on operational matters concerning the forces he was organizing, training and equipping. This state of affairs remained until 1944 when the position was abolished with the remaining Kustenfliegerstaffeln and Bordfliegergruppe came under the control of the General der Aufklarungsflieger (General of Air Reconnaissance).[39]

The organization of the Luftwaffe

The Luftwaffe of World War II was a fiercely independent service and, like our modern USAF, was the youngest of the services within the Deutsche Wehrmacht, or German Armed Forces. The Luftwaffe organizational structure was organized along the levels of war, although it was not labeled as such at the time. (Figure 1)[40] The Luftwaffe was organized along territorial boundaries with a separate operational and support structure.[41] During times of war, these territorial commands "stretched" to cover the area of conflict within their pre-war borders. Reichsmarschall Hermann Goering served in s dual capacity as Reichsminister der Luftfahrt (Minister of Aviation) and Oberbefehlshaber der Luftwaffe (Commander-in-Chief of the Air Force). As Reichsminister der Luftfahrt, Reichsmarschall Goering was the head of civil aviation.

This aspect of German aviation will not be explored further in this paper. As Oberbefehlshaber der Luftwaffe, Goering was charged with the administration and operations of the Luftwaffe.[42] The Reichskanzler (Reichs Chancellor), Adolf Hitler, was the political head of the Wehrmacht. The Oberkommando der Wehrmacht (High Command of the Armed Forces or OKW) was responsible for the strategic planning and direction of the entire German war machine. The OKW was the rough equivalent of the Joint Chiefs of Staff (JCS), except the OKW wielded a greater amount of influence and power than the JCS does. Below the OKW was each service's Oberkommando, in this case the Oberkommando der Luftwaffe, or OKL. The OKL, under the leadership of Reichsmarschall Goering, had the task of planning the overall operational strategy of the war. In combined operations, the commander with the preponderance of assets would assume command of the joint operations (today's Joint Task Force Commander), thus retaining the unity of command. This commander would then be directly responsible to the OKW for the operations under his control.[43] (Figure 2)

The largest tactical commands were the Luftflotten, or Air Fleets. Each Luftflotte was responsible for a particular geographical area. (Figure 3) This area of assignment was not permanent and an entire Luftflotte could be moved from area to area. Each Luftflotte had an operational and support structure. The Luftflotte headquarters was responsible for coordinating all internal activities. The Fliegerkorps, or Flying Corps, was the next level of command. The Luftflotte could control one or several Fliegerkorps, depending upon situational requirements. The Fliegerkorps could also be detached from its "parent" Luftflotte and assigned to another Luftflotte. The Fliegerkorps structure was very elastic and the number and type of aircraft assigned varied from one Luftflotte to another. This is just the opposite of the British method of organization, which grouped like aircraft under the same unit. The modern U.S. equivalent

would be the Air Expeditionary Force (AEF), which blends different combat and support aircraft types from specific units. Prior to the AEF, the Numbered Air Force (NAF) organizational structure would have closely modeled the Fliegerkorps. However, most NAFs have become type specific, and thus no longer fit the Fliegerkorps analogy.[44]

A special subordinate command existed in the form of a Fliegerführer (Flying Leader). The Fliegerführer was a special commander responsible for highly specialized operations on certain fronts. Although assigned one or two specialized missions, the Fliegerführer controlled all types of aircraft that operated in their area of operations. Each "task force" under Fliegerführers consist of flying units composed of mixed types of aircraft which cannot come directly under the charge of a Fliegerkorps or Luftflotte owing to the special nature of their tasks and to geographical considerations.[45] The unit organization assigned to each Fliegerführer was atypical of the current Luftwaffe tactical structure, with various Geschwader, Gruppe and Staffeln an integral part of the command. The three Fliegerführer (Fliegerführer 3, 4 and 5) assigned to Luftflotte V were tasked with anti-shipping and weather reconnaissance missions. However, each Fliegerführer had a diverse mix of aircraft, from seaplanes to long-range fighters to level bombers.[46]

The largest homogeneous combat formation in the Luftwaffe was the Geschwader. The Geschwader could have up to 120 aircraft assigned, organized into three Gruppen. The Geschwader is equivalent to the modern USAF Wing. The Geschwader would have the same basic type of aircraft, bombers for example, but the make and model might differ, such as the first and second Gruppe might be equipped with He 111s and the third Gruppe with Ju 88s. The basic combat unit of the Luftwaffe was the Gruppe. The Gruppe, usually consisted of 27 to 36 aircraft, although this could vary widely, was the smallest autonomous organization within the

Luftwaffe. The Gruppe had its own operational and support structure for the conduct of combat operations. Operations orders were usually issued in terms of Gruppen for execution at the tactical level. Gruppen usually had three Staffeln assigned, with between five and 20 aircraft assigned. It is at the Gruppe and Staffel level that are roughly equivalent to a squadron in today's USAF.[47]

For tactical execution, the Staffel had three basic formations of aircraft. The Schwarm, with five planes assigned, was the basic fighting unit in the air. If the situation dictated, the Schwarm could be divided into a Ketten of three planes or a Rotten of two planes. Regardless of the type of aircraft assigned, each level, from the Schwarm to the Rotten, emphasized tactical flexibility and mutual support. The nearest USAF equivalent would be the flight or wingman. It was at this level that the Germans excelled at continuous improvement, as witnessed by operations throughout the war.[48]

"There is nothing more common than to find considerations of supply affecting strategic lines of a campaign and a war."

Carl von Clausewitz

With the ghost of Clausewitz looking over its shoulders the Luftwaffe organized dedicated administrative and supply organizations. These were the Luftgau. (Figure 4) The Luftgau were stationary commands assigned to well-defined and permanently fixed geographical areas. The army equivalent was the Wehrkreis area, which emphasized the geographical nature of the organization. Theoretically, each Luftflotte was assigned a specific Luftgau for operational support.[49] The primary functions of a Luftgau were administration, supply and maintenance of flying units; air defense operations; communications, training and reserve personnel operations.[50] The Luftgau was divided into five Flughafenbereichkommandaturen

(Airfield Regional commands) which were responsible for administrative control of each Einsatzhafenkommandaturen and thus were not necessarily located at an airfield. The Flughafenbereichkommandaturen acted as an administrative intermediary between the Luftgau and the Einsatzhafenkommandaturen (Operational Airdrome Commands), but had a functional responsibility for the actual transportation of supplies and equipment from depots to the subordinate commands . Each Flughafenbereichkommandaturen was further divided into approximately five or more Einsatzhafenkommandaturen that served the actual flying units at their assigned airfield with administrative and logistical support.[51]

Operationalizing the war in the Atlantic

While the See-Luftstreitkrafte functioned as part of the navy under the supervision of the General der Luft, the Luftwaffe was slowly, and painfully, developing a fledgling maritime support force. This force developed in recognition of the importance of mine warfare in countersea antisurface warfare (ASUW) operations. Luftflotte 2, commanded by General der Flieger Helmuth Felmy was tasked by Reichsmarschall Goering to "…investigate all questions relative to the preparation for and conduct of naval warfare…"[52] Two units were specifically created for these operations. Fliegerkorps X, under the command of Generalleutnant Geisler, was tasked with the anti-shipping mission. General Geisler was a "perfect fit" because he had the knowledge needed to lead this fledgling force. His previous pioneering work demonstrated the Luftwaffe can be very effective in the Maritime role.[53] Fliegerkorps X developed as the liaison between Luftflotte 2, Oberkommando Marine West and Oberkommando Luft West for mission planning and coordination. Fliegerdivision 9 was developed as the operational unit of Fliegerkorps X to conduct aerial mine warfare. Mine warfare is divided into two basic subdivisions: mine laying for area denial degrades the enemy's capabilities to wage land, air, and

maritime warfare; and countering enemy–laid mines permits friendly use of land or sea areas. Mine warfare air operations support the broad task of establishing and maintaining control of vital sea areas. Mining impedes the flow of traffic through a given area. The most expedient minefield laying operations are accomplished by aircraft. Mine countermeasures prevent the enemy from laying mines and involve actions to reduce or eliminate mines already laid by an enemy.[54]

Joint control from higher echelons appeared to be weak; however, good communication and organizational collaboration made up for this lack of leadership.[55] Joint Luftwaffe-Kriegsmarine cooperation results were mixed. The action officers at Fliegerkorps X and Oberkommando Marine West improved communications and exchanged map Grid Systems in order to understand each other's references and smooth operational and tactical coordination. Two early successes in the war at sea proved the efficacy of this system. Oberkommando Marine West requested reconnaissance of British merchant shipping in the North Sea. Luftflotte 2 and Oberkommando Luft West coordinated the tasking and information was provided in a timely manner. The attack on British merchant shipping was carried out by Oberkommando Luft West because they were the only forces equipped with torpedo planes at the time.[56] The second success occurred on 26 September 1939 with an attack against the Royal Navy aircraft carrier *Ark Royal*. After being found by Oberkommando Luft West seaplanes, Fliegerkorps X aircraft were guided to the fleet units and conducted the attack.[57] This operation was seen as a success of the cooperation between the Luftwaffe and Kriegsmarine. In reality, this was a death knell of the See-Luftstreitkrafte. Goering used this outstanding operational cooperation as rationale to take the remaining fixed-wing combat aircraft from the Kriegsmarine and place them under Luftwaffe control.

This modus operandi continued until the creation of the Fliegerführer Atlantik. The Fliegerführer Atlantik was created by Reichsmarschall Goering to provide an organization to conduct a coherent anti-shipping strategy for the Battle of the Atlantic. Assigned to Fliegerkorps IV, which was subordinate to Luftflotte 3, Fliegerführer Atlantik's duties were to conduct the war against enemy shipping in the Atlantic in cooperation with the Commander-in-Chief Unterseebooten and Oberkommando Marine West, to safeguard the arrival and departure of German surface and subsurface forces to and from their bases, and to conduct operations against enemy supply shipping in the event of enemy landings.[58]

Still, the chain of command proved a hindrance at times. A perfect example is an incident that occurred in the autumn of 1940 concerning a spot report by an FW 200 Condor reconnaissance aircraft. Per established operational procedure, the crew of the FW 200 reported a convoy to their home station at Bordeaux-Merignac. The report then was passed to the headquarters of Fliegerkorps IV. The Fliegerkorps then transferred the information to Luftflotte 3 then on to Marinegruppe West and finally to Commander-in-Chief Unterseebooten. By the time the U-Boat headquarters received the report, it was too late to act upon. Many times this reporting chain took over a day to complete the cycle. This had the effect of negating any sightings by FW 200 crews, but it did provide Grossadmiral Doenitz with the "battle rhythm" of convoy operations. Once again, the Luftwaffe vigorously fought placing the FW 200 units directly under Kriegsmarine control.[59]

Summary

"The Luftwaffe's wartime organization allowed it to execute its operational tasks in as smooth a fashion as possible…Each air fleet was, in effect, a miniature air force, fielding its own complement of fighter, long range fighter, bomber, dive bomber, ground attack, reconnaissance,

and transport aircraft."[60] So, why did the Luftwaffe-Kriegsmarine cooperative effort dictated by Luftwaffe Regulation 16 fail? Why were Luftflotte 5 and Fliegerführer Atlantik not successful? Sonke Neitzel succinctly states it best: "Without doubt the ultimate reason for this sorry state of affairs was the lack of adequate leadership in the upper echelons of the Luftwaffe high command. There was no qualified personality *with influence* who was able to stand up for the interests of the navy after the war broke out and the Luftwaffe had to accomplish numerous other tasks."[61]

Luftwaffe Technology

The leadership and battle of the Luftwaffe are decisively influenced by technology. Aircraft models, weapons, munitions, radios, it cetera, are in constant development. The means of attack are in constant competition with the means of defense. During the course of a war, discoveries and improvements in materiel can have an enormous effect upon the state of hostilities….
Luftwaffe Regulation 16, The Conduct of Aerial War[62]

The Luftwaffe started the war at the cutting edge of current technology in the area of aircraft development. The aerial tactics employed by the Luftwaffe were some of the most innovative and effective in the world. While the British stuck by their Vic formation and its inherent tactical weaknesses, the Germans developed a four-aircraft formation, the Schwarm that took advantage of mutual support and proved highly effective to aerial fighting. This innovation, however, did not permeate the entire Luftwaffe. As a matter of fact, with few exceptions, the Luftwaffe fought the entire war with the same basic airframe technology it started the war with.

Throughout World War II, the Luftwaffe maintained strict control of the development of aircraft and munitions. At the heart of this technological discussion, as it pertains to the Luftwaffe's support of maritime operations, is the development of a four-engine bomber, the

aerial torpedo, remotely guided weapons and innovative solutions to precision guidance of aircraft over the long-ranges required for maritime operations. Once again, the German senior leadership directly interfered with the development of key technology that could have made a significant difference in the war effort at sea. However, the realities of the war at sea forced the German hand and some outstanding technological developments influenced tactical operations of the Atlantic Campaign.

Naval aviation development and use

As part of the memorandum between Reichsmarschall Goering and Grossadmiral Raeder, the See-Luftstreitkrafte was initially equipped as an all-seaplane force. The primary functions of the See-Luftstreitkrafte were long-range reconnaissance, mine laying, torpedo operations against an enemy fleet and naval cooperation. The Heinkel 59 (He 59) was ship-based and the primary mine layer and torpedo attack aircraft of the See-Luftstreitkrafte. (Illustration 1) The Dornier 18 (Do 18) (Illustration 2) and the Heinkel 60 (He 60) (Illustration 3) were the long-range reconnaissance platforms, the Do 18 being land based and the He 60 ship-based. Both the He 59 and He 60 fulfilled the naval cooperation role, which included liaison between ships, reconnaissance and aerial gunfire spotting and correction.[63]

Another concept the Kriegsmarine initiated was the development of an aircraft carrier. Although Grossadmiral Raeder was a "battleship admiral," he believed the development of a carrier force was necessary to compete on the open seas with the British Fleet. Four aircraft carriers were included in the ambitious "Z Plan" for Kriegsmarine expansion, which was wholeheartedly endorsed by Hitler. The purpose of the aircraft carrier was to provide commerce-raiding capital ships and cruisers with mobile air cover during operations. The first of these was the Kriegsmarine Schiff *Graf Zeppelin*, (Illustration 4) launched in December, 1938. Due to conflicting requirements and arguments over design work, construction was an on-again, off-again proposition. Work finally ceased in 1943, with the ship being scuttled at war's end. In the continuing saga of control of aviation assets, the air wing of the carrier would have been manned by Luftwaffe crews.[64]

Three aircraft types were developed for use aboard the aircraft carrier force. Two proven designs were adapted for sea service, the Me 109 and the Ju-87. The Me 109T (for Trager or

Carrier) (Illustration 5) was based on the proven Me 109E-1 version, with provision for catapult launches and an arrestor hook. The Me 109T would provide local air defense for the task force and fighter cover for the dive bombers. Development work ceased in 1943 and all 70 were converted to land-based fighters and designated Me 109T-2s. The Ju-87C was a Ju-87B-1 with provision for catapult launches, an arrestor hook and folding wings. (Illustration 6) Naturally, the Ju-87C was the offensive weapon for the task force and would have been used in its natural dive-bomber role. Finally, the true "step-child" of the carrier aircraft was the Me-155. (Illustration 7) The Me-155 was based on the Me 109 airframe and originally designed as a carrier-based fighter. The usual interference by the senior Luftwaffe leadership led to the Me-155 transitioning to a level-bomber and finally a high-altitude interceptor. With the cancellation of the carrier building program in 1943, the Me-155 was temporarily shelved. Blohm und Voss received the program with the intent of creating a land-based high altitude interceptor. The Bv-155 was thus born and development was finally ended when the Blohm und Voss factory was captured by American forces in 1945.[65] (Illustration 8)

Aircraft and operations of Fliegerführer Atlantik

Fliegerführer Atlantik used three main categories of aircraft to accomplish four distinct missions. Reconnaissance, bomber and fighter aircraft performed reconnaissance, anti-surface warfare attack (ASUW), anti-submarine attack (ASW) and air superiority missions, with each type often performing more than one mission area. The reconnaissance task involved surface search tasks -- looking for convoys. Once a convoy was found, its location was reported and the reconnaissance aircraft "shadowed" the enemy ships until the attack was consummated. If multiple unarmed ships or single armed merchantmen were encountered, the reconnaissance aircraft may attack individually or as part of a combined U-Boat/aerial attack. The ASUW

mission was usually carried out by armed reconnaissance aircraft or bombers, either singly or in groups, this being dependent on enemy defensive capabilities. The ASW mission was performed in conjunction with submarine chasers or independently if submarine chaser vessels were not available. It is interesting to note that ASW missions were only carried out by Luftwaffe aerial assets along the immediate coastal areas (Littoral ASW).[66]

The Principles Governing the Conduct of Operations by Fliegerführer Atlantik and An Appreciation of the Types of Aircraft Available was issued by the Fliegerführer Atlantik Headquarters Staff on December 3rd, 1943. This document was designed as broad tactical guidance for subordinate units in the employment of their aircraft and recommendations, or "lessons learned" for improving assigned aircraft. It is interesting to note that the first line under "Operational instructions from the C. in C. Luftwaffe" is: "Strategy against enemy shipping in the Atlantic *in cooperation with* C. in C. U-Boats and Naval Group West." [Emphasis added] This document listed the following aircraft types as operational under Fliegerführer Atlantik: The Focke Wulf 200 Kondor (Fw 200 Condor), (Illustration 9) the Heinkel 177 Greif (He 177 Griffon), (Illustration 10) the Junkers 290 See Adler (Ju 290 Sea Eagle), (Illustration 11) the Junkers 88D-1 and A-4 (Ju 88D-1, Ju 88A-4), (Illustration 12) the Blohm und Voss 222 Wiking (BV 222 Viking), (Illustration 13) the Blohm und Voss 138 (Bv 138), (Illustration 14) the Focke Wulf 190 (Fw-190) (Illustration 15) and the Arado 196 (Ar 196). (Illustration 16)

In 1943, Fliegerführer Atlantik's reconnaissance force consisted of the Fw 200, the Ju 290, the Ju 88D- or A-4, the Bv 222 and the Bv 138. The Fw 200 Kondor began life as a civil airliner. Ordered by the Japanese in significant numbers, the Fw 200 developed into a successful military killing machine, earning the moniker "Scourge of the Atlantic." The main weakness of the Fw 200 was operations against enemy fighters. To quote the Fliegerführer Atlantik staff:

"Recent encounters between FW 200s and enemy TE (long-range) fighters when cloud cover has been insufficient have nearly always led to the destruction of the FW 200." This being said, the Fw 200 was not recommended for further development because it had been exploited to the limit of its capability and was being replaced by the He 177.[67] An interesting side note is that the Fw 200 menace was directly credited with the initial development of catapult launched Sea Hurricanes (whose pilot launched by catapult to defend the merchantman then had to ditch and be recovered from the ocean) and later the development of the Escort Carrier for use in escorting Allied convoys. The Ju 290, like the Fw 200, was developed from an airliner design. That being said, the Ju 290 was a far more capable airplane with better armor protection and defensive weapons. Unlike the Fw 200, the Ju 290 was approved for operations where enemy fighters were operating. The Fliegerführer staff stated "At the moment the Ju 290 is the most suitable aircraft for Atlantic reconnaissance." The chief recommendation was to arm the Ju 290 with the Fritz X glider bomb.[68] The Ju 88 was did not fully meet the requirements for either range or speed for overwater reconnaissance but "has to be used by Fliegerführer Atlantik for sea reconnaissance in areas covered by British day and night fighters.[69] The Bv 222 was the seaplane of choice for long-range reconnaissance and was comparable to the Ju 290 in capabilities, except for defensive armament and speed. The Bv 138 was only acceptable for coastal patrol and ASW duties because of its lack of speed and short radius of action.[70]

The Fliegerführer Atlantik bomber assigned bomber aircraft included the much maligned He 177. The He 177 developed protracted teething problems, both in development and in operational use. However, it was the only heavy bomber available to the Germans in World War II. The He 177A-5 was the dedicated anitshipping version and could use the LuftTorpedo 5b (LfT 5b), the Hs 293 missile (Illustration 17) and the Fritz X glide bomb.[71] (Illustration 18) The

key recommendations were to increase its radius of action and allow for a quick conversion from Fritz X carrier to torpedo bomber.[72]

The fighter force equipment for Fliegerführer Atlantik included the C6/R2, G1 and H2 models of the Ju 88, various models of the Fw 190 and the Ar 196. The Ju 88 was seen as the fighter for Fliegerführer Atlantik operations. The armament and radius of action was adequate, with an increase in the latter preferred. The Fw 190 was favored for its firepower and maneuverability for use against British fighters, but the short range severely hampered extended operations. The Ar 196 was considered an obsolete design suitable only for coastal reconnaissance and ASW work.[73]

The evolution of air-to-surface guided weapons

The Luftwaffe, consistent with its continental orientation towards war, completely ignored aerial torpedo development. Considered as a naval weapon, the Luftwaffe only took an interest in air-delivered torpedoes in 1941, after the failure of direct bombing of Allied shipping because of better defensive armament.[74] The Luftwaffe Chief of Staff, General Hans Jeschonnek, liked to argue that bombs were cheaper than torpedoes! Later, when it was proven that aerial torpedoes worked, he tried to remove all aerial torpedoes from the See-Luftstreitkrafte so "his" Luftwaffe would have the exclusive right to use them.[75] The Luftwaffe finally realized that it needed the stand off capability of the torpedo. This too came with a price, as the Luftwaffe found out during operations. The aircraft adapted as torpedo bombers, Ju 88s and He 111s, were not very maneuverable when flying within torpedo launch parameters. As a result, the torpedo bombers usually had to overfly their targets after release. This had the predicted result of increasing losses to the attacking airplane. Cajus Bekker highlights the problems of Luftwaffe-Kriegsmarine infighting as it concerned weapons development when he stated the

following: “Lack of inter-service co-operation at top level was also notable in the matter of mines and torpedoes. In particular, the development of an airborne version of the latter was left to the Navy’s test centre, without for a long time producing results. Torpedo planes consequently only came into general use in 1942, by which time the available types were relatively slow and ponderous.”[76]

As a result of the mounting losses, the Luftwaffe developed the first precision guided munitions (PGMs). The Henschel Hs 293A-1 guided missile and the Ruhrstahl/Kramer X-1, or SD 1400 Fritz X, guided bomb were developed to increase the standoff distance between the launching aircraft and the target. The main difference between the two weapons was the Hs 293 sustained powered flight into the target (Figure 5) while the Fritz X relied on sheer gravity for penetration (Figure 6). Both the Hs 293 and the Fritz X relied on the bombardier to track a flare marker on the rear of the weapon until impact with the target. The Hs 293 was first used successfully against British destroyers in the Bay of Biscay and the Fritz X was used against the cruiser *USS Savannah* off the coast of Italy in 1943.

Remote guidance of aircraft

To assist in long-range overwater navigation, the Germans adapted their radio navigation systems to maritime use. The first of these systems, Knickebein, or “Crooked Leg,” was based on the Lorenz blind landing aid. The Lorenz used two radio beams that intersected at the point of landing on a runway. The Lorenz signal had a range of 30 miles, obviously not far enough for bombing another country. The Knickebein system used two transmitters, one on the coast of Denmark and one on the coast of France, to transmit intersecting beams across a designated target area. These radio signals were broken tones that went steady as the airplane flew over the intersection of the beams. This gave the bombardier the signal to release his bombs. The British

developed a countermeasure for this system, so the Germans developed the X-Gerät, or X Device.[77]

X-Gerät used specialized radio equipment to receive more accurate, higher frequency radio signals. The X-Gerät monitored four different transmitting stations for proper operation of the system. Each station was named after a river in Germany, with the master stations being called Weser. The cross signals were named Rhine, Oder and Elbe. By using four radio transmitters, the system was twice as accurate as Knickebein. About 30 km from the target the radio operator would hear a brief signal from Rhine, and set up his equipment. This consisted primarily of a stopwatch with two hands. When the signal from Oder was heard the operator started the clock and two hands started to sweep up from zero. When he heard the signal from Elbe he "started" the clock again, at which point one hand would stop and the other would start moving back towards zero. Oder and Elbe were aimed to be at exactly 10 and 5 km from the bomb release point at the line of Weser, meaning that the clock accurately measured the time to travel 5km, and thus calculated the ground speed of the plane. Since the time taken to travel that 5km should be almost identical to the time needed to travel the last 5km from Elbe to the target, when the moving hand reached zero the bombs were automatically released. The British eventually developed countermeasures to these devices, however, they pioneering role they played in the future of long-range radio navigation, such as LORAN, was key. By using long range radio guided navigation, the Luftwaffe was able to more accurately determine the locations of enemy fleets and convoys. This accuracy greatly increased their ability to target the enemy and thus proved to be a force multiplier.

Summary

"Perhaps with no other weapon is the interaction of tactics and technology, and their mutual dependency, as great as in the air force."

Generalleutnant Walther Wever, November, 1935

"The development of the Luftwaffe's air armament validated Wever's assertion. The Luftwaffe's technological lead over its adversaries was never again so great as it had been in 1939-40…Still, the resilience, talent for improvisation, and the adaptability of the Luftwaffe units schooled for operational air warfare made them a force to be reckoned with into the final months of the war."[78] By restricting the See-Luftstreitkrafte to a seaplane force and the only users of the aerial torpedo, the Luftwaffe greatly hindered the conduct of the War in the Atlantic. Fliegerführer Atlantik was properly equipped as a combat air force to carry out maritime operations. After a slow start with weapons development (the torpedo and bomb) and adapting available airframe technology (the Fw 200 and Ju 88), the Germans did the best they could with what they had. German technical prowess developed new and innovative ideas for guided air-to-surface guided weapons and homing methods to increase navigational accuracy. While it is true that the Allies developed countermeasures for these inventions, credit is still due to the Germans for overcoming obstacles with their usual operational efficiency.

Conclusion

"Future historiography will be united in one point: it is simply incomprehensible that the Germans fought the war at sea without air reconnaissance or a naval air force, as if – in the 20th century, the century of light – aircraft did not exist."

Grossadmiral Karl Doenitz, to Adolf Hitler

The examination of doctrine, thought, organization and technology can tell much about a nations' military. If doctrine development is truly evolutionary, learning the right lessons from history, then the doctrine will be sound. Too often, though, in the heat of battle, a country's armed forces will not have this luxury. Such was the case for the German Luftwaffe of World War II. The increased operations tempo caused by a multi-front war, forced the Luftwaffe into a dogmatic doctrine development cycle.

This paper examined Luftwaffe thought and doctrine. Through this critical analysis, it is more easily understood about the lack of preparation on the Luftwaffe's part for maritime operations. After Wever's untimely death, the Luftwaffe was not prepared for the important maritime role it had to play in World War II.

After seeking the doctrine and thought that prevailed in the pre-war Luftwaffe, it is important to look at the Luftwaffe's organizational structure. The Luftwaffe as an organization was flexible enough to make adjustments as new missions were created. Instead of being fully prepared for the War in the Atlantic, the Luftwaffe became a victim of "mission creep." The ability of the organization to adapt to these increasing roles is testament to the operational and tactical leadership, not the strategic and political leadership.

Finally, this paper discussed the Luftwaffe's aircraft, weapons and tactical innovation and the roles each played. The importance of aircraft development cannot be overstated. The main Luftwaffe aircraft with which it started the war were still in service at the end of the war. Bitter infighting highlights German weapons development of World War II. If the German senior leadership would not have interfered with weapons development so much, the cost of the maritime war could have been much higher. Finally, German technological ingenuity continually developed better methods of fighting. This challenged the Allies, but in the end, the Allies prevailed through skill and many times, sheer luck. The Battle for the Atlantic had the best of both of these.

Bibliography

Air Force Doctrine Document 2-1.4, *Countersea Operations*, 4 June 1999.

Anttonen, Harri. "Luftflotte 1." The Luftwaffe in Southern Finland 1941-1944, n.p. On-line. Internet, 14 February 2005. Available from http://www.geocities.com/finnmilpge/fmpg_lw_lfl1.html?200514.

AP500, "Introduction to Expeditionary Air and Space Power." Lecture. Air Command and Staff College, Maxwell AFB, Al., 2 November 2004.

Arps, Lt Col Leslie H. and Lt Col Frank V. Quigley. "The Origin, Development, and Organization of the German Air Ministry and the Luftwaffe, October 1, 1945," 570.04-1, in the USAF Collection, AFHRA.

Arsenal of Dictatorship, n.p. On-line. Internet, 14 February 2005. Available from http://www.geocities.com/pentagon/2833/.

Bekker, Cajus. *The Luftwaffe War Diaries.* Garden City, New York: Doubleday & Company, 1968.

British Air Ministry. *The Rise and Fall of the German Air Force 1933-1945.* Poole, England: Arms & Armour Press, 1983.

Brookes, Andrew. *Air War Over Russia.* Hersham, England: Ian Allen Publishing, 2003.

Claasen, Adam R. A. *Hitler's Northern War: The Luftwaffe's Ill-Fated Campaign, 1940-1945.* Lawrence, Kansas: University Press of Kansas, 2001.

Corum, James S. and Richard R. Muller. *The Luftwaffe's Way of War: German Air Force Doctrine 1911-1945.* Baltimore, Maryland: The Nautical & Aviation Publishing Company of America, 1998.

Corum, James S. *The Luftwaffe: Creating the Operational Air War, 1918-1940.* Lawrence, Kansas: University Press of Kansas, 1997.

Deichmann, General der Flieger a. D. Paul. *German Air Force Operations in Support of the Army,* USAF Historical Studies: No. 163 Maxwell AFB, AL: USAF Historical Division, Air University, 1962.

Deichmann, General der Flieger Paul. *Spearhead For Blitzkrieg: Luftwaffe Operations in Support of the Army, 1939-1945* London, England: Greenhill Books, 1996.

Dewey, William T. *The Development of Air Doctrine in the German Air Force* (1919-1942). Air War College Research Report No. 39 Maxwell AFB, AL: Air University, 1977.

Ethell, Jeffrey L. *Eagles over North Africa and the Mediterranean 1940-1943.* London, England: Greenhill Books, 1997.

Evans, Mark Llewellyn. *Great World War II Battles in the Arctic.* Westport, Connecticut: Greenwood Press, 1999.

Forsyth, Robert. *Mistel: German Composite Aircraft and Operations 1942-1945.* Crowborough, England: Classic Publications, 2001.

G.A.F. Organization and Historical Notes, "Air Publication 1928, 2nd Edition, April, 1943 - Notes on the German Air Force," 512.6314U Vol I, 1945, in the USAF Collection, AFHRA.

G.A.F. Organization and Historical Notes, "Air Publication 3038, November, 1943 – The German Air Force in Maps and Diagrams, 1939-1943," 512.6314U Vol I, 1945, in the USAF Collection, AFHRA.

G.A.F. Organization and Historical Notes, "War Department Technical Manual TM-E 30-451, Handbook on German Military Forces, 1 March 1945, Chapter X," 512.6314U Vol I, 1945, in the USAF Collection, AFHRA.
German Translation No. V11/102, "The Operational Use of the Luftwaffe in the War at Sea, 1939-1943."K-512.621 V11/102, Copy 1, in the USAF Collection, AFHRA.
German Translation No. V11/120, "Principles Governing the Conduct of Operations by Fliegerführer Atlantik and an Appreciation of the Types of Aircraft Available," K-512.621 V11/120, Copy 1, in the USAF Collection, AFHRA.
German Translation No. V11/60, "German Air Attacks on PQ Convoys," 512.621 V11/60, in the USAF Collection, AFHRA.
German Translation No. V11/64, "The Use of Bomber Units for Reconnaissance," 512.621 V11/64, in the USAF Collection, AFHRA.
German Translation No. V11/65, "The Mediterranean Campaign," 512.621 V11/65, in the USAF Collection, AFHRA.
German Translation No. V11/72, "The Course of the War in the Mediterranean Theater of Operations, (1 January-13 May 1943)," 512.621 V11/72, in the USAF Collection, AFHRA.
Griehl, Manfred. *Airwar over the Atlantic.* London, England: Greenhill Books, 2003.
Gross, Chris. *Bloody Biscay: The story of the Luftwaffe's only long range maritime fighter unit, V Gruppe / Kampfgeschwader 40, and its adversaries 1942-1944.* Manchester, England: Crecy Publishing Limited, 2001.
Gustin, Emmanuel. "The Focke-Wulf Fw 200 Condor." uboat.net, n.p. On-line. Internet, 14 February 2005. Available from http://www.uboat.net/technical/fw200.htm.
Hallion, Richard P., *Air Warfare and Maritime Operations,* Paper Number 45 (Fairbairn, Australia: RAAF Air Power Studies Centre, 1996)
Hart, W.E. *Hitler's Generals.* Garden City, New York: Doubleday, Doran & Company Inc., 1944.
Hayward, Joel S. A., *Stopped at Stalingrad: The Luftwaffe and Hitler's Defeat in the East, 1942-1943.* Lawrence, Kansas: University Press of Kansas, 1998.
Holm, Mike. "High Command of the Luftwaffe." Feldgrau.Com, n.p. On-line. Internet, 14 February 2005. Available from http://www.feldgrau.com/articles.php?ID=41.
Hooton, E. R. *Eagle In Flames: The Fall of the Luftwaffe.* London, England: Brockhampton Press, 1999.
Hooton, E. R. *Phoenix Triumphant: The Rise and Rise of the Luftwaffe.* London, England: Arms & Armour Press, 1994.
Howarth, Stephen and Derek Law, ed. *The Battle of the Atlantic 1939-1945: The 50th Anniversary International Naval Conference.* London, England: Greenhill Books, 1994.
Howarth, Stephen, ed. *Men of War: Great Naval Leaders of World War II.* New York, New York: St. Martin's Press, 1992.
Jones, R.V. *The Wizard War: British Scientific Intelligence 1939-1945*. New York, New York: Coward, McCann & Geoghegan, Inc., 1978.
Keegan, John. *The Second World War*. New York, New York: Penguin Books, 1989.
Koestner, Oberstleutnant Marc S. "The Luftwaffe's Support of Naval Operations during World War II 1939-1941" Master's thesis, Canadian Forces College, n.d.
Mann, Chris, and Christer Jorgensen. *Hitler's Arctic War: The German Campaigns in Norway, Finland, and the USSR 1940-1945*. New York, New York: Thomas Dunne Books, 2002.
Mitchum Jr., Samuel W. *Eagles of the Third Reich.* Novato, California: Presidio Press, 1997.

Muller, Richard. *The German Air War In Russia.* Baltimore, Maryland: The Nautical & Aviation Publishing Company of America, 1992.
Murray, Williamson, and Allan R. Millett, *A War to be Won: Fighting the Second World War*. Cambridge, Massachusetts: Belknap Press, 2000.
Murray, Williamson. *German Military Effectiveness.* Baltimore, Maryland: The Nautical & Aviation Publishing Company of America, 1992.
Murray, Williamson. *Luftwaffe.* Baltimore, Maryland: The Nautical & Aviation Publishing Company of America, 1985.
Murray, Williamson. *Strategy for Defeat The Luftwaffe 1933-1945.* Maxwell AFB, Alabama: Air University Press, 1983.
Neitzel, Sonke. "Kriegsmarine and Luftwaffe Co-operation in the War against Britain, 1939-1945," War In History, Volume 10, Number 4 (November 2003).
Neitzel, Sonke. *Der Einsatz der deutschen Luftwaffe uber dem Atlantik und der Nordsee 1939-1945.* Bonn, Germany: Bernard & Graefe Verlag, 1995.
Nowarra, Heinz J. *Focke-Wulf Fw 200 Condor: Die Geschicte des ersten modernen Langstreckenflugzueges der Welt.* Koblenz, Germany: Bernard & Greafe Verlag, 1988.
Overy, Richard. *Why the Allies Won*. New York, New York: W. W. Norton & Company, 1995.
Philpott, Bryan. *German Maritime Aircraft.* Tucson, Arizona: Aztex Corporation, 1981.
Pipes, Jason and David Wadman. "Kriegsmarine Naval Air Power." Feldgrau.Com, n.p. On-line. Internet, 14 February 2005. Available from http://www.feldgrau.com/kms-luft.html.
Poolman, Kenneth. *Focke-Wulf Condor: Scourge of the Atlantic.* London, England: Macdonald and Jane's, 1978.
Price, Alfred. *Instruments of Darkness: The History of Electronic Warfare*. New York, New York: Charles Scribners's Sons, 1978.
Price, Alfred. *Luftwaffe Handbook 1939-1945.* New York, New York: Charles Scribner's Sons, 1977.
Price, Alfred. *Luftwaffe: Birth, life and death of an air force.* New York, New York: Ballantine Books, 1973.
Price, Dr Alfred. *Pictorial History of the Luftwaffe.* Shrewsbury, England: Airlife Publishing, 1991.
Price, Dr Alfred. *The Luftwaffe Data Book.* London, England: Greenhill Books, 1997.
Raeder, Erich. *My Life.* trans. Henry W. Drexel. Annapolis, Maryland: United States Naval Institute, 1960.
Rosch, Barry C. *Luftwaffe Code, Markings & Units 1939-1945.* Atglen, Pennsylvania: Schiffer Military/Aviation History, 1995.
Smith, Peter C. *The Sea Eagles: The Luftwaffe's Maritime Operations 1939-1945.* London, England: Greenhill Books, 2001.
Spick, Mike. *Luftwaffe Bomber Aces: Men, Machines, Methods.* London, England: Greenhill Books, 2001.
Staerk, Christopher, and Paul Sinnot. *Luftwaffe: The Allied Intelligence Files.* Washington, D.C.: Brassey's, Inc., 2002.
Stahl, P.W. *KG 200: The True Story.* London, England: Jane's, 1981.
Suchenwirth, Richard. *Historical Turning Points in the German Air Force War Effort.,* USAF Historical Studies: No. 189. Maxwell AFB, AL: USAF Historical Division, Air University, 1959.

van der Vat, Dan and Christine van der Vat. *The Atlantic Campaign: World War II's Great Struggle at Sea.* New York, New York: Harper & Row Publishers, 1988.
Ward, John. *Hitler's Stuka Squadrons: The JU 87 at War 1936-1945.* Staplehurst, England: Spellmount Limited, 2004.
Weal, John. *Junkers Ju 87 in North Africa and the Mediterranean.* London, England, 1998.
Yoder, Mike. "Battle of Stalingrad – Der Kessel." MilitaryHistoryOnline.Com, n.p. On-line. Internet, 14 February 2005. Available from http://www.militaryhistoryonline.com/wwii/stalingrad/kessel.aspx.

Figures

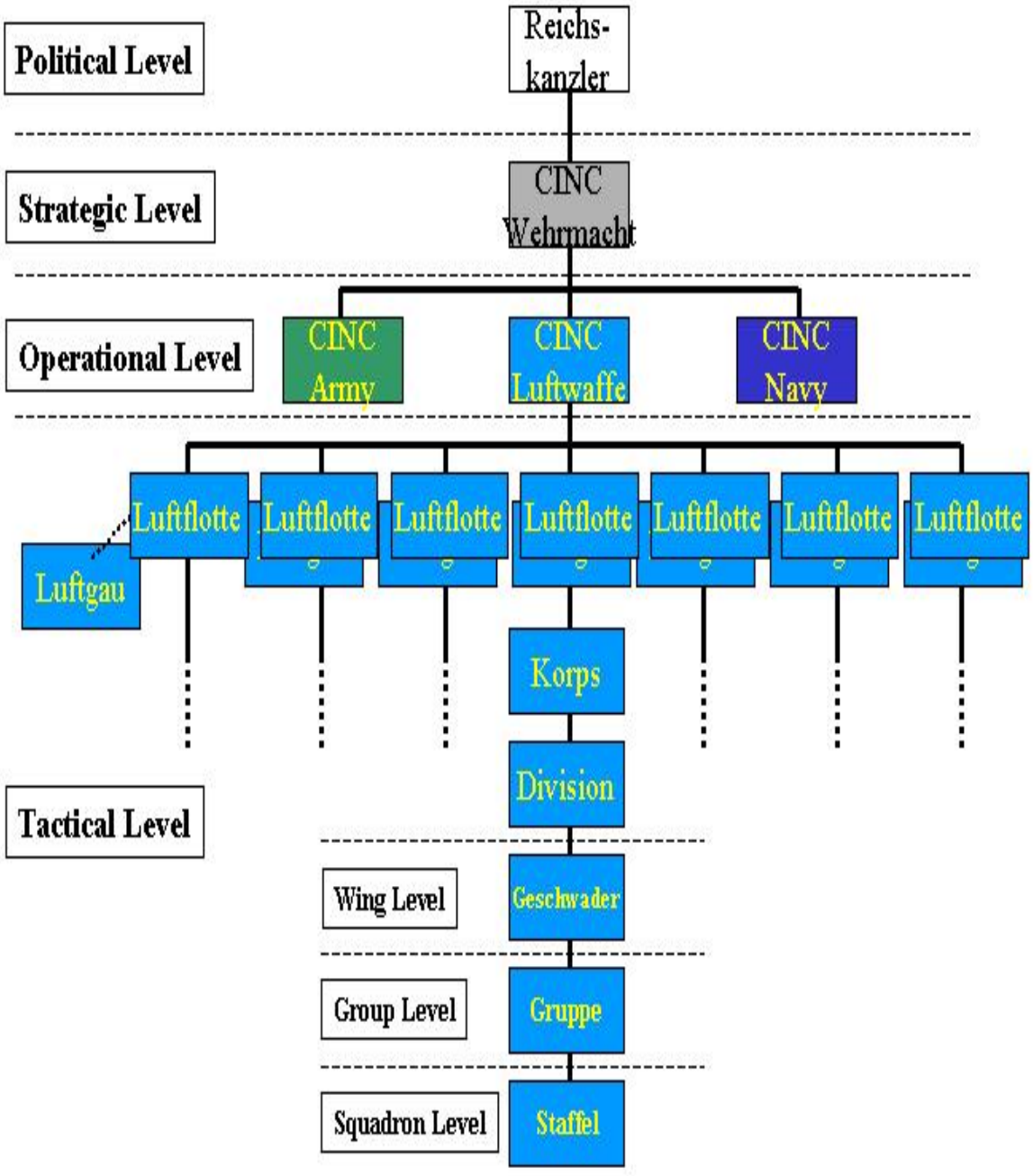


Figure 1. Luftwaffe Organization and the Levels of War

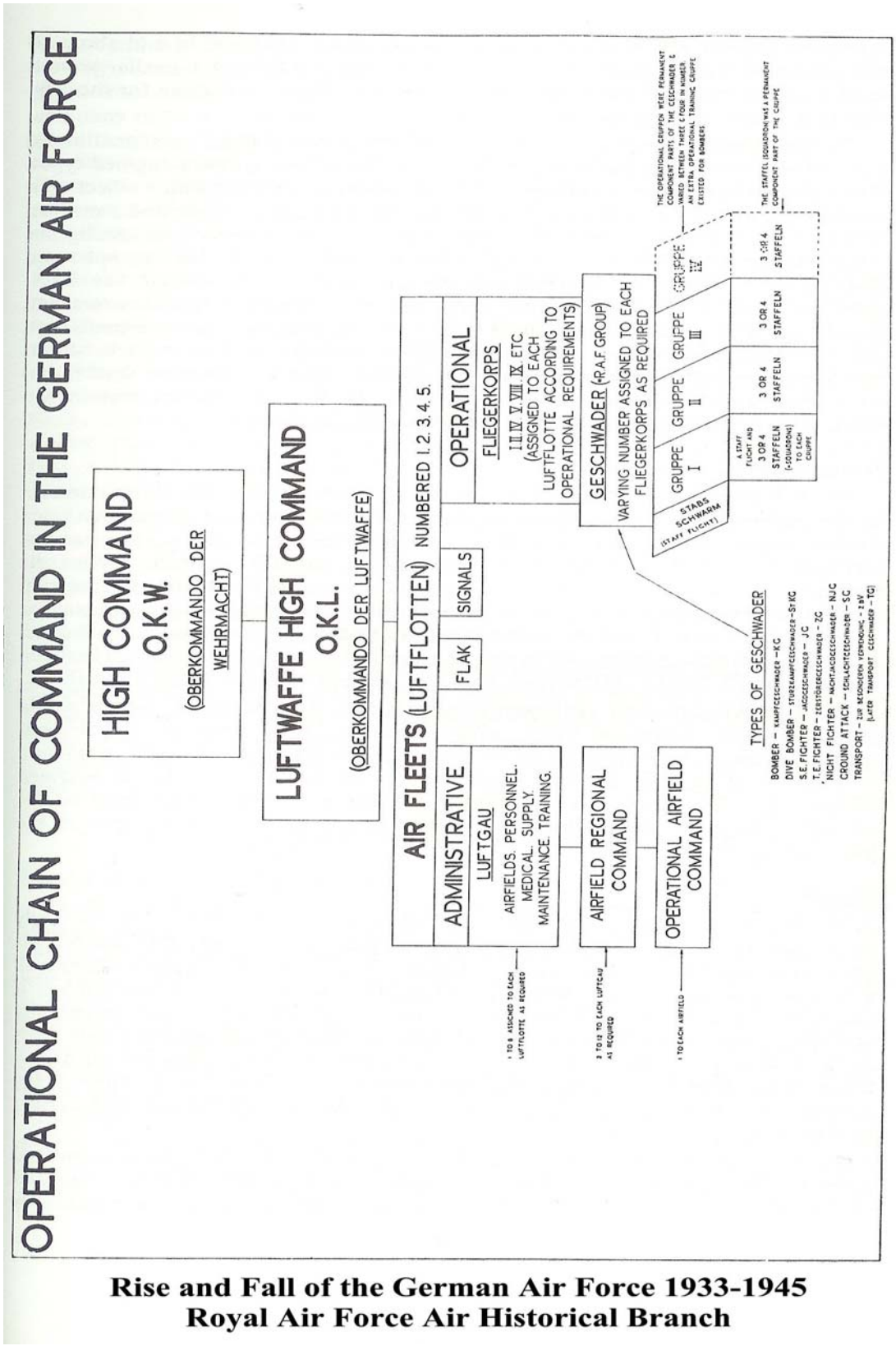
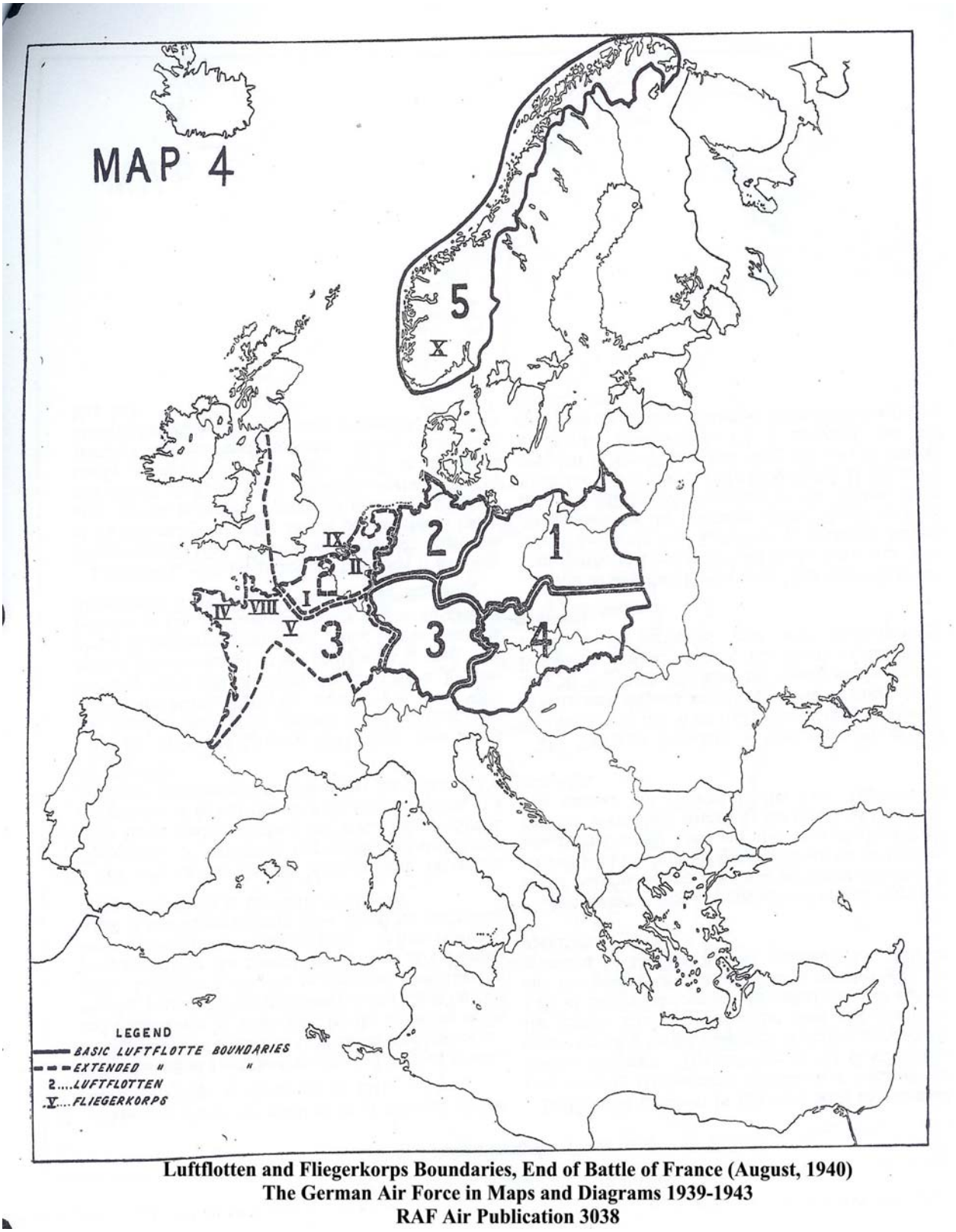


Figure 2. Luftwaffe Operational Chain of Command



Luftflotten and Fliegerkorps Boundaries, End of Battle of France (August, 1940)
The German Air Force in Maps and Diagrams 1939-1943
RAF Air Publication 3038

Figure 3. Luftflotten and Fliegerkorps Boundaries, 1940

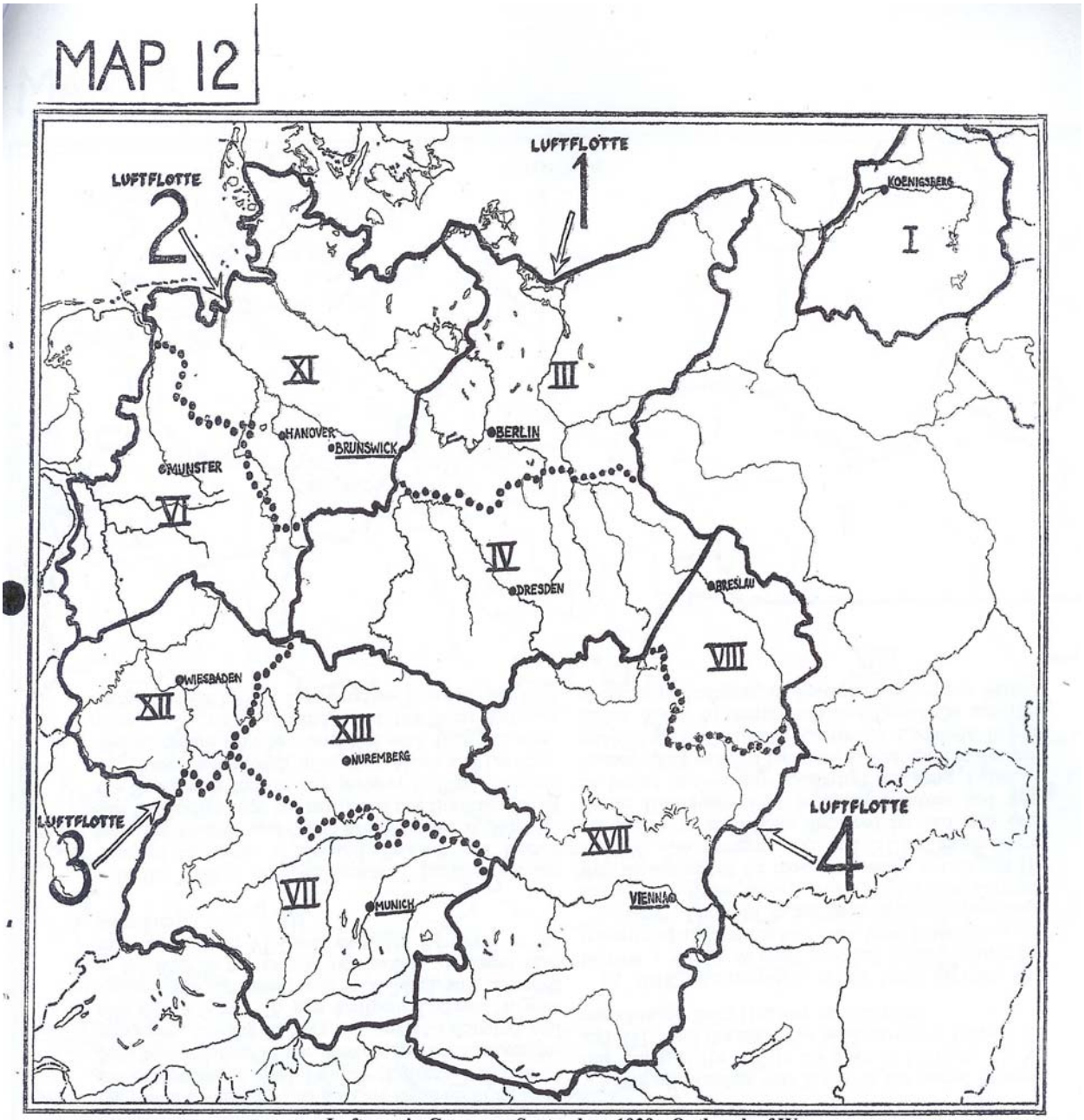


Figure 4. Luftgau Boundaries, September, 1939

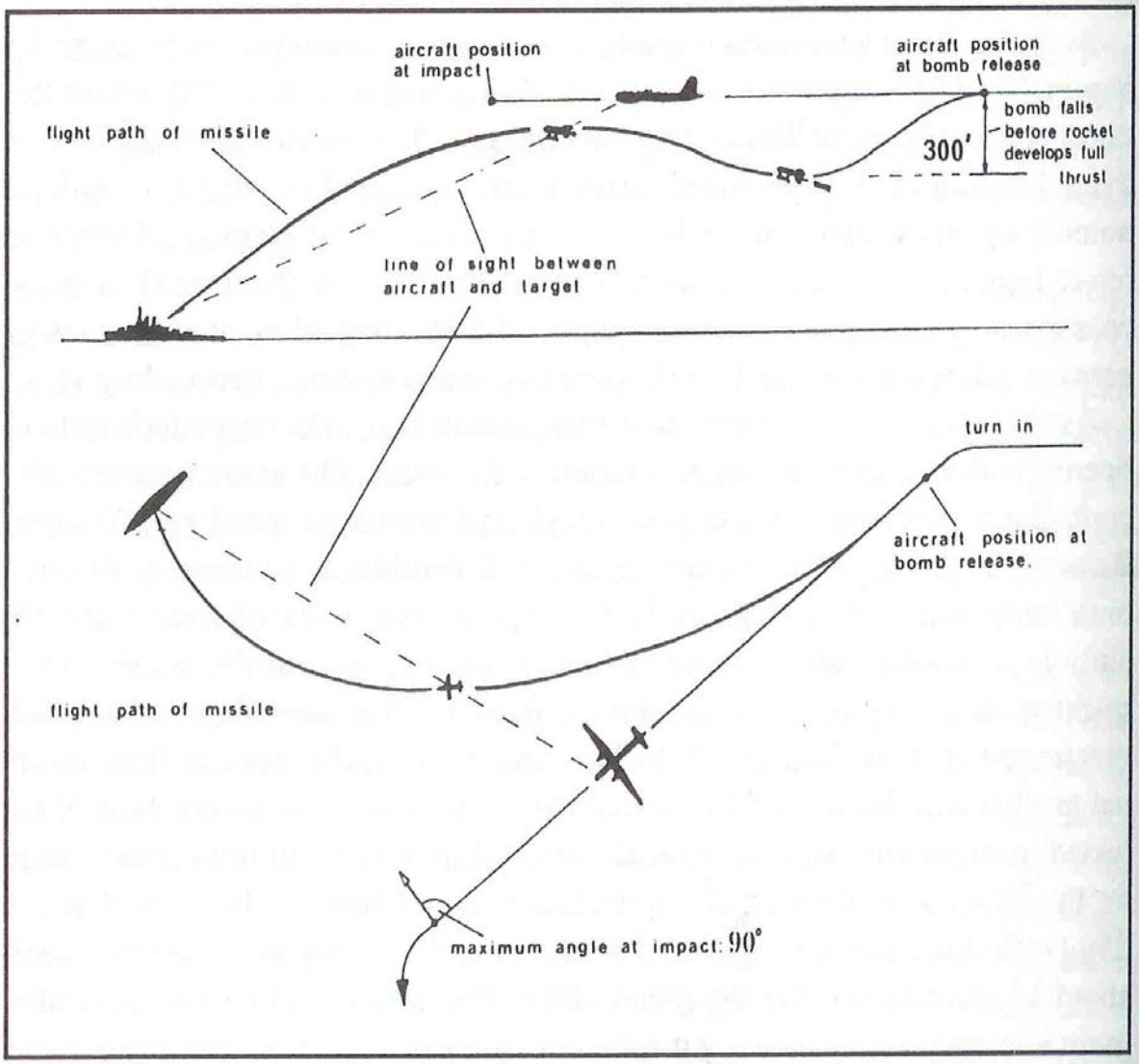


Fig. 12. Typical attack with an Hs 293 glider bomb. The range of the parent aircraft from the target at missile release varied between 4,000 and 20,000 yards, giving a time of flight for the missile of between 30 and 110 seconds. During the final part of its flight the observer in the aircraft guided the flare in the missile so that it remained superimposed over the target. He held it there until the missile impacted.

Luftwaffe Data Book, Dr. Alfred Price, Pg 184

Figure 5. HS 293 Attack Profile

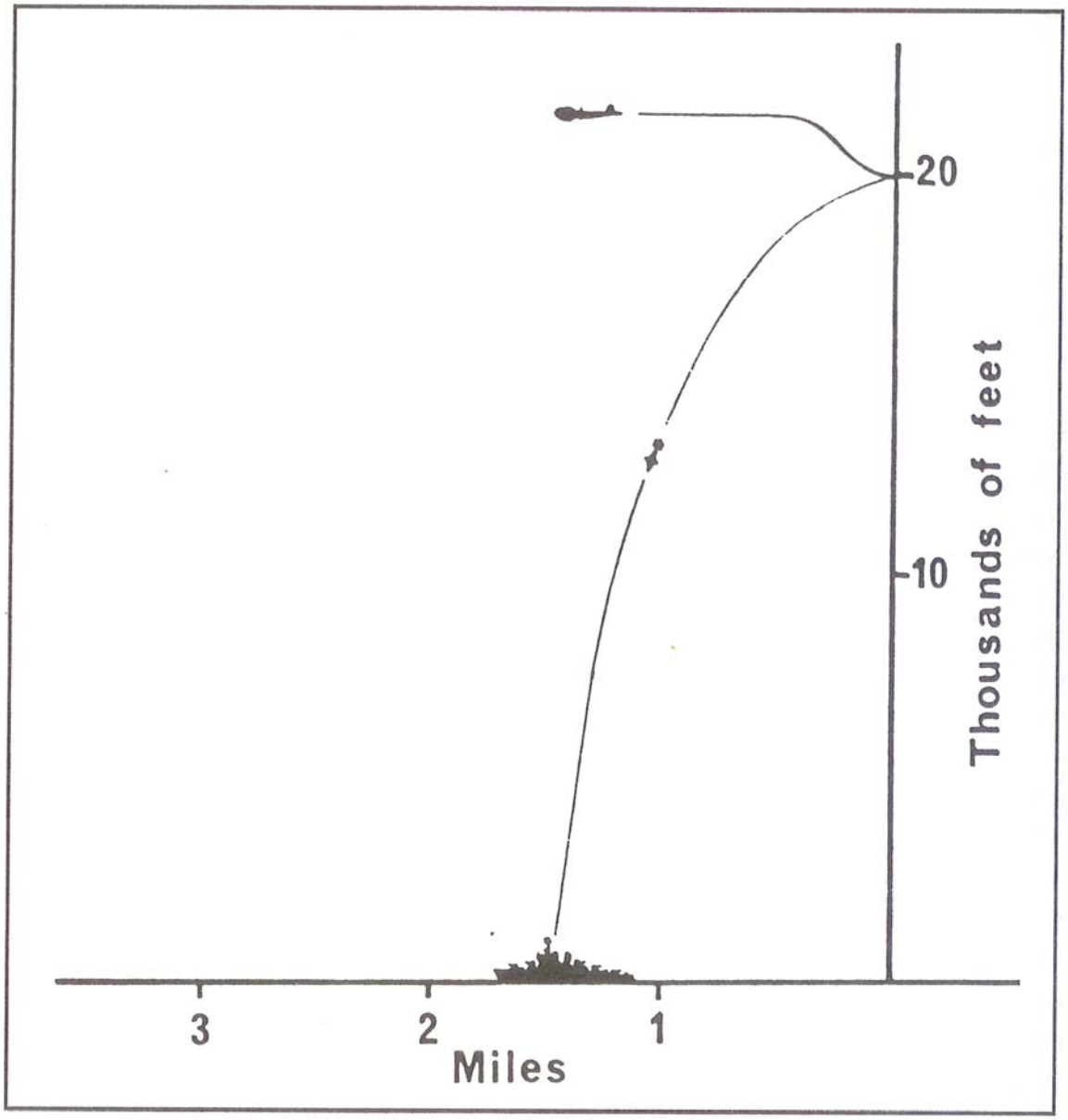
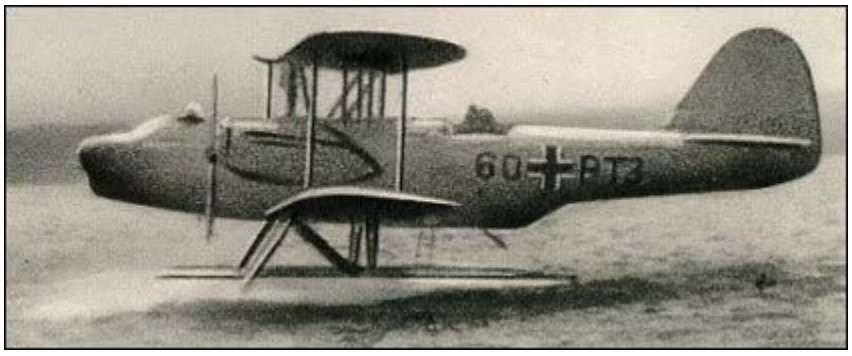


Fig. 13. Typical attack using the Fritz-X guided bomb. The launching aircraft delivered the weapon from an altitude of 20,000 feet or above, to give it sufficient velocity to pierce the armoured deck of a large warship. The observer aimed the weapon in the normal way, using the Lotfe 7 *bomb sight. After release of the guided bomb, the pilot throttled back the engines and climbed the aircraft through 1,000 feet. He thus reduced speed rapidly, which enabled him to hold the aircraft over the bomb's line of trajectory. During the final part of the bomb's fall the observer guided the tracking flare so that it was superimposed on the target, until the weapon impacted.*

Luftwaffe Data Book, Dr. Alfred Price, Pg 186

Figure 6. Fritz-X Attack Profile

ILLUSTRATIONS



http://www.russian.ee/~star/air/germany/he-59.html

Illustration 1 (He 59)

http://www.russian.ee/~star/air/germany/dorn_do-18.html

Illustration 2 (Do 18)

http://www.warbirdsresourcegroup.org/LRG/he60.html

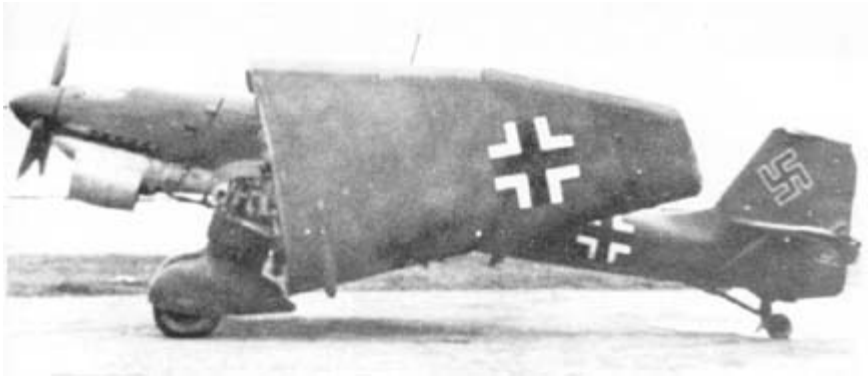
Illustration 3 (He 60)

http://www.geocities.com/pentagon/2833/kriegsmarine/carrier/grafzeppelin/grafzeppelin.html

Illustration 4 (*KMS Graf Zeppelin*)

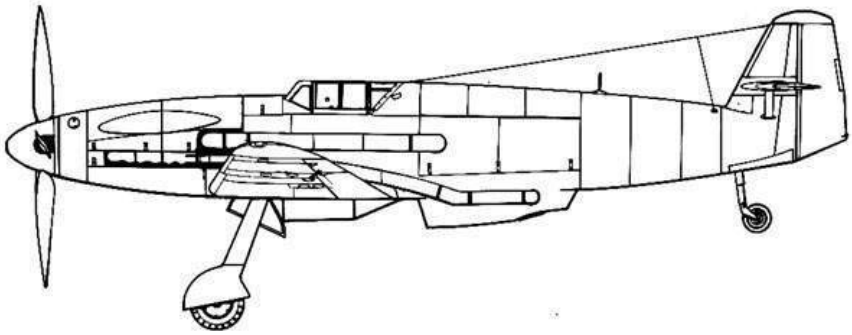
http://www.geocities.com/pentagon/2833/luftwaffe/carrierborne/me109t/me109t.html

Illustration 5 (Me 109T)



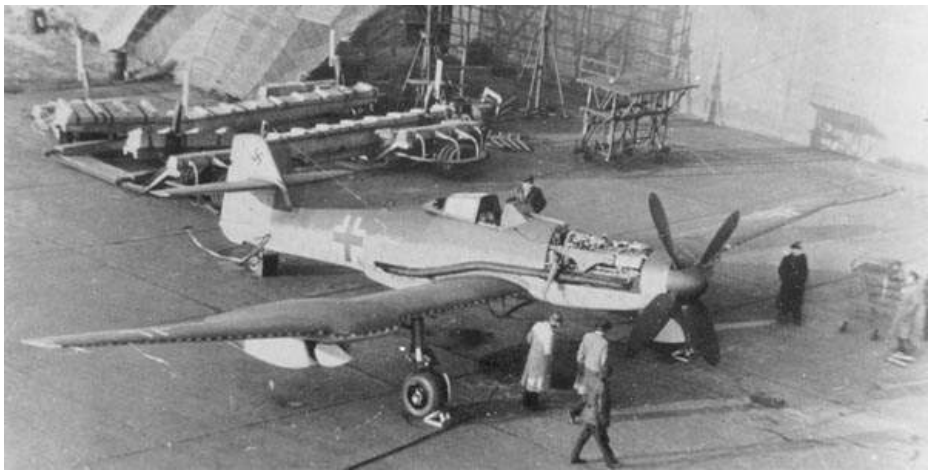
http://www.geocities.com/pentagon/2833/luftwaffe/carrierborne/ju87c/ju87c.html

Illustration 6 (Ju 87T)



http://www.xs4all.nl/~tozu/me109/family/me155.htm

Illustration 7 (Me 155)



http://www.xs4all.nl/~tozu/me109/family/bv155.htm

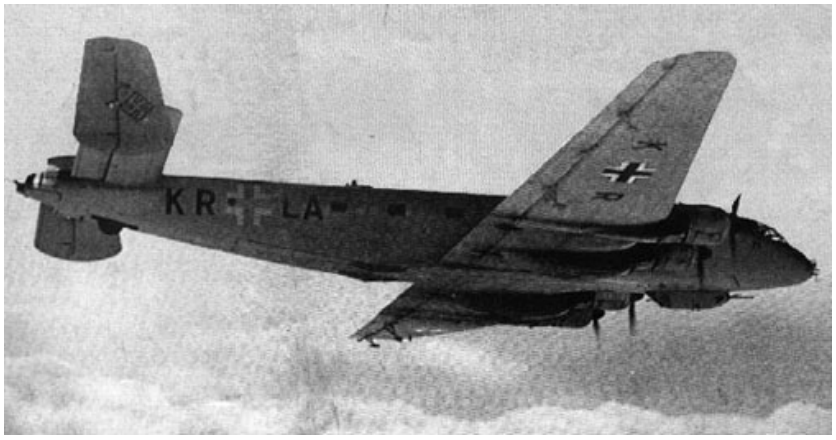
Illustration 8 (Bv 155)

http://uboat.net/technical/fw200.htm

Illustration 9 (Fw 200)

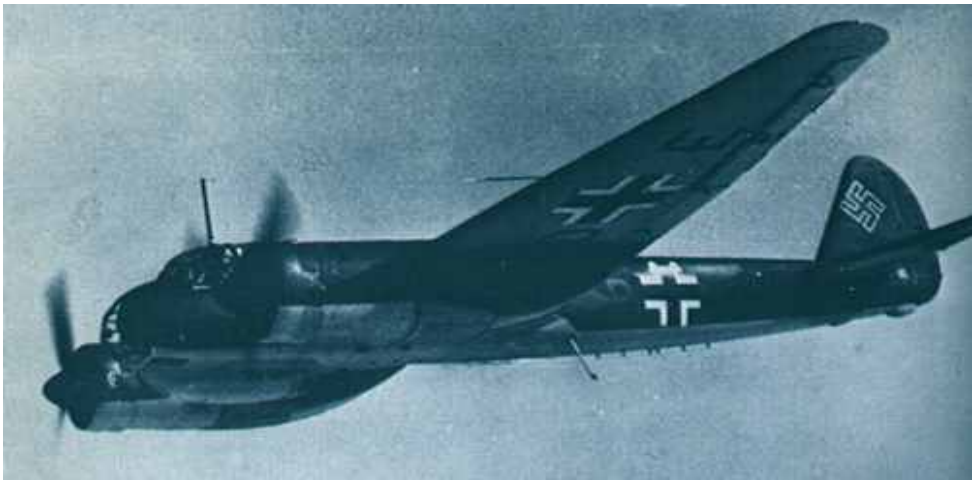
http://www.warbirdsresourcegroup.org/LRG/he177.html

Illustration 10 (He 177)



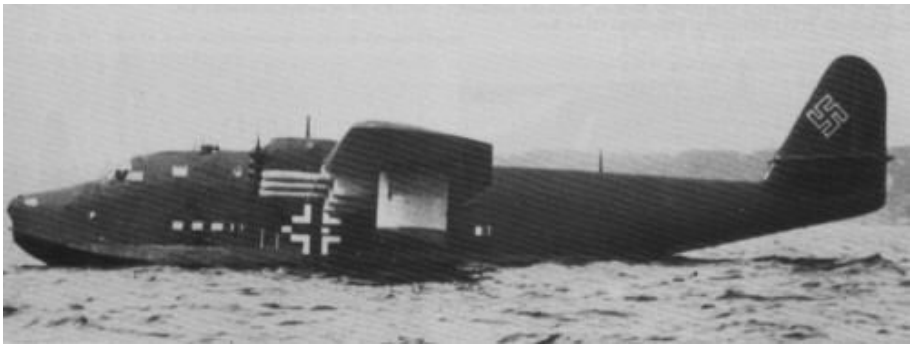
http://www.warbirdsresourcegroup.org/LRG/ju290.html

Illustration 11 (Ju 290)



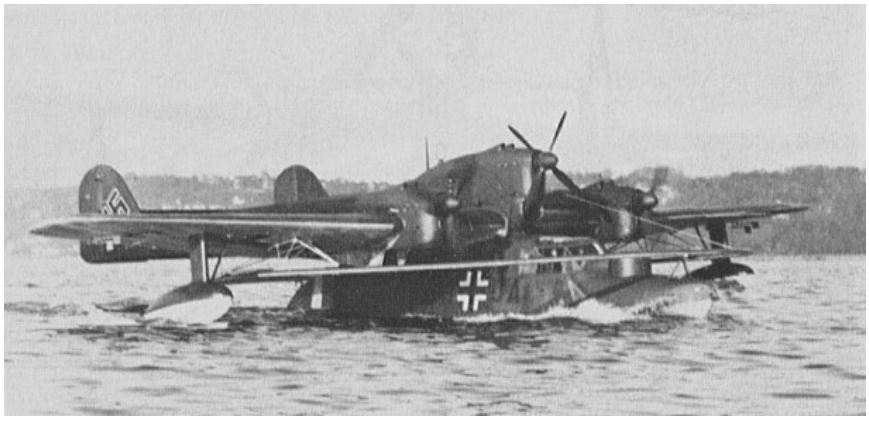
http://uboat.net/technical/images/ju88-1.jpg

Illustration 12 (Ju 88)



http://www.simviation.com/fsdcbainbv222.htm

Illustration 13 (Bv 222)



http://www.warbirdsresourcegroup.org/LRG/bv138.html

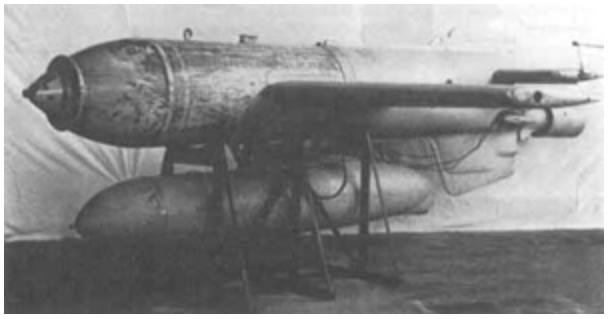
Illustration 14 (Bv 138)

http://hsgm.free.fr/rajoutsguerre/aviation/fw190.jpg

Illustration 15 (Fw 190)

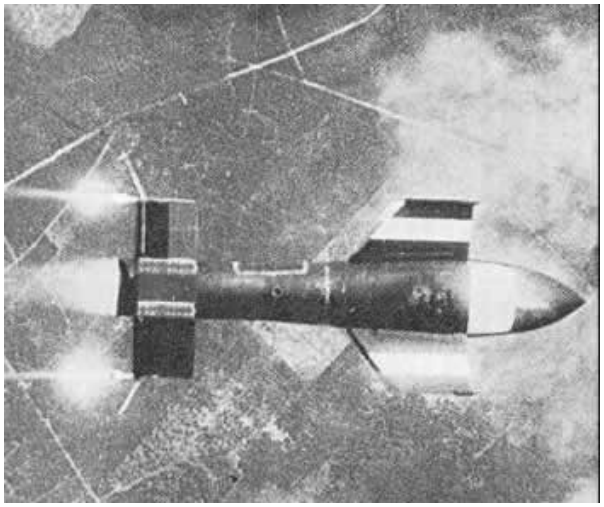
airwar.valka.cz/muzeum/ nemecko/ar_196/popis.htm

Illustration 16 (Ar 196)



http://www.bdli.de/geschichte/zivile_luftfahrt/bilder/Hs293-300.jpg

Illustration 17 (Hs 293)



http://exordio.com/1939-1945/militaris/batallas/Italia/salerno.html

Illustration 18 (Fritz X)

End Notes

[1] AP500, "Introduction to Expeditionary Air and Space Power." Lecture. Air Command and Staff College, Maxwell AFB, Al., 2 November 2004.
[2] Kenneth Poolman, *Focke-Wulf Condor: Scourge of the Atlantic* (London, England: Macdonald and Jane's, 1978), 8.
[3] British Air Ministry, *The Rise and Fall of the German Air Force 1933-1945* (Poole, England: Arms & Armour Press, 1983), 42.
[4] Ibid., AP500.
[5] James S. Corum, *The Luftwaffe: Creating the Operational Air War, 1918-1940* (Lawrence, Kansas: University Press of Kansas, 1997), 129.
[6] Ibid., 131.
[7] James S. Corum and Richard R. Muller, *The Luftwaffe's Way of War: German Air Force Doctrine 1911-1945* (Baltimore, Maryland: The Nautical & Aviation Publishing Company of America, 1998), 91.
[8] Ibid., 118.
[9] British Air Ministry, *The Rise and Fall of the German Air Force 1933-1945* (Poole, England: Arms & Armour Press, 1983), 42.
[10] Sonke Neitzel, "Kriegsmarine and Luftwaffe Co-operation in the War against Britain, 1939-1945," War In History, Volume 10, Number 4 (November 2003), 457.
[11] Ibid.
[12] Andrew Brookes, *Air War Over Russia* (Hersham, England: Ian Allen Publishing, 2003)105.
[13] Oberstleutnant Marc S. Koestner, "The Luftwaffe's Support of Naval Operations during World War II 1939-1941" (master's thesis, Canadian Forces College, n.d.), 14.
[14] Richard Suchenwirth, *Historical Turning Points in the German Air Force War Effort,* USAF Historical Studies: No. 189 (Maxwell AFB, AL: USAF Historical Division, Air University, 1959), 15.
[15] James S. Corum and Richard R. Muller, *The Luftwaffe's Way of War: German Air Force Doctrine 1911-1945* (Baltimore, Maryland: The Nautical & Aviation Publishing Company of America, 1998), 118.
[16] Ibid., Koestner, 16.
[17] General der Flieger a. D. Paul Deichmann, *German Air Force Operations in Support of the Army,* USAF Historical Studies: No. 163 (Maxwell AFB, AL: USAF Historical Division, Air University, 1962), 18.
[18] Ibid., Corum/Muller, 274.
[19] William T. Dewey, *The Development of Air Doctrine in the German Air Force* (1919-1942), Air War College Research Report No. 39 (Maxwell AFB, AL: Air University, 1977), 31.
[20] Ibid., Suchenwirth, 3.
[21] Ibid.
[22] Ibid.
[23] E.R. Hooton, *Phoenix Triumphant: The Rise and Rise of the Luftwaffe* (London, England: Arms & Armour Press, 1994), 212.
[24] Sonke Neitzel, "Kriegsmarine and Luftwaffe Co-operation in the War against Britain, 1939-1945," War In History, Volume 10, Number 4 (November 2003), 450.

[25] Stephen Howarth, ed., *Men of War: Great Naval Leaders of World War II* (New York, New York: St. Martin's Press, 1992), 69.
[26] Ibid., Howarth, 71.
[27] Adam R. A. Claasen, *Hitler's Northern War: The Luftwaffe's Ill-Fated Campaign, 1940-1945* (Lawrence, Kansas: University Press of Kansas, 2001), 159.
[28] Ibid., Claasen, 208.
[29] Ibid.
[30] Ibid.
[31] Ibid., Koestner, 9.
[32] Ibid., Koestner, 19.
[33] Ibid., Koestner, 23.
[34] German Translation No. V11/102, "The Operational Use of the Luftwaffe in the War at Sea, 1939-1943."K-512.621 V11/102, Copy 1, in the USAF Collection, AFHRA, 1.
[35] Ibid., Koestner, 24.
[36] Ibid., German Translation V11/102, 1.
[37] G.A.F. Organization and Historical Notes, "Air Publication 3038, November, 1943 – The German Air Force in Maps and Diagrams, 1939-1943," 512.6314U Vol I, 1945, in the USAF Collection, AFHRA, Map 23.
[38] Ibid., Koestner, 27.
[39] Jason Pipes and David Wadman. "Kriegsmarine Naval Air Power." Feldgrau.Com, n.p. On-line. Internet, 14 February 2005. Available from http://www.feldgrau.com/kms-luft.html
[40] Ibid., Koestner, 8.
[41] G.A.F. Organization and Historical Notes, "War Department Technical Manual TM-E 30-451, Handbook on German Military Forces, 1 March 1945, Chapter X," 512.6314U Vol I, 1945, in the USAF Collection, AFHRA, X-1.
[42] Ibid.
[43] Ibid.
[44] Ibid., X-4.
[45] Ibid., G.A.F. Organization, Air Publication 3038, GAF in Maps & Diagrams, AP3038, Map 23.
[46] Ibid., G.A.F. Organization, TM-E 30-451, X-6.
[47] Ibid., X-5.
[48] Ibid., X-5.
[49] Ibid., X-6.
[50] Ibid., X-7.
[51] G.A.F. Organization and Historical Notes, "Air Publication 1928, 2nd Edition, April, 1943 - Notes on the German Air Force," 512.6314U Vol I, 1945, in the USAF Collection, AFHRA, 36.
[52] Ibid., Koestner, 32.
[53] Ibid., Koestner, 33.
[54] Air Force Doctrine Document 2-1.4, *Countersea Operations*, 4 June 1999
[55] Ibid., Koestner, 34.
[56] Ibid., Koestner, 35.
[57] Ibid., Koestner, 35.

[58] German Translation No. V11/120, "Principles Governing the Conduct of Operations by Fliegerführer Atlantik and an Appreciation of the Types of Aircraft Available," K-512.621 V11/120, Copy 1, in the USAF Collection, AFHRA, 1.
[59] Ibid., Neitzel, 454.
[60] Ibid., Corum/Muller, 11.
[61] Ibid., Nietzel, 452.
[62] Ibid., Corum/Muller, 119.
[63] Ibid., Koestner, 28.
[64] Arsenal of Dictatorship, n.p. On-line. Internet, 14 February 2005. Available from http://www.geocities.com/pentagon/2833/
[65] Ibid.
[66] Ibid., German Translation V11/120, 2.
[67] Ibid., German Translation V11/120, 3.
[68] Ibid., German Translation V11/120, 4.
[69] Ibid.
[70] Ibid.
[71] Ibid., Arsenal of Dictatorship.
[72] Ibid., German Translation V11/120, 4.
[73] Ibid., German Translation V11/120, 5.
[74] British Air Ministry, *The Rise and Fall of the German Air Force 1933-1945* (Poole, England: Arms & Armour Press, 1983), 112.
[75] Ibid., Neitzel, 452.
[76] Cajus Bekker, *The Luftwaffe War Diaries* (Garden City, New York: Doubleday & Company, 1968), 274.
[77] Price, Alfred. *Instruments of Darkness: The History of Electronic Warfare*. New York, New York: Charles Scribners's Sons, 1978., 21.
[78] Ibid., Corum/Muller, 15.